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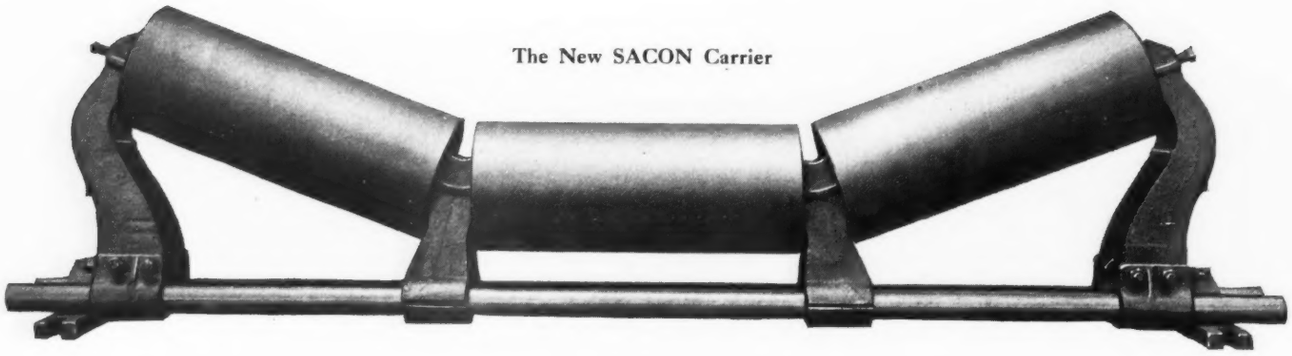
The Present Trend In Metallurgical Practice In Northern Ontario
By Henry Hanson

World's Iron Ore Resources
By Olin R. Kuhn

Advantages Of Cubes Over Balls As Grinding Media
By E. H. Rose

Lithographic Limestone In Manchuria
By Hironao Nishihara



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Contents

*Illustrated Article

Editorials 81
- Publicity Policies in Mining
- How to Mine Without Ore
- Organized Minorities
- Significance of Differential Flotation
- Railroad Rates and Ore Reserves
- A Belated Notice of Public Hearing
- Use of Cubical Grinding Media
- Petroleum Research

***World's Iron-Ore Resources Now Exceed 57,000,000,000 Tons** 84
By Olin R. Kuhn

***Present Trend in Metallurgical Practice in Northern Ontario** 94
By Henry Hanson

***Advantages of Cubes Over Balls as Grinding Media** 95
By E. H. Rose

Discovery of Lithographic Stone Made in Manchuria 100
By Hironao Nishihara

Discussion 101
- The Comstock Barren Belt
- Encouragement for Mining Engineers
- Mine Promotion and Mine Financing
- The Metric System
- Ancient Man in Nevada

Mining News 104
- Sale of Eagle Picher Lead Co.
- Kingdom Lead Mine
- Kellogg Zinc Plant
- Gold-Silver Discovery, Topley, B. C.
- Washington News
- Letters from London, Johannesburg and Melbourne

Situation at the Mines 111

Societies, Addresses and Reports 112

Men You Should Know About 113

Obituaries 113

Recent Technical Publications 114

New Machinery 115

Markets 117

Company Reports 119

Mining Stocks 120

Searchlight Section 44-46

Professional Directory 47-49

What and Where to Buy 50

Advertising Index 54

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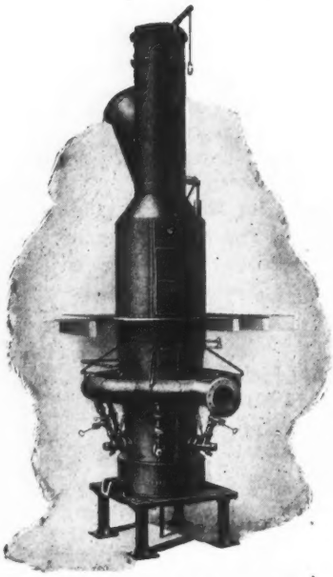
Water Jacketed Blast Furnaces for Copper and Lead Ores



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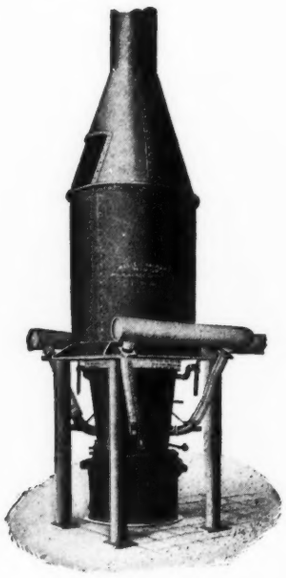

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ENGINEERING AND
MINING JOURNAL

JOSIAH EDWARD SPURR, Editor

Volume 122 | New York, July 17, 1926 | *Number* 3

Publicity Policies in Mining

THE GENERAL SPIRIT in American industry as to sharing good ideas, new devices, facts, and information is good as a whole. There is, on the average, a frankness, a spirit of give-and-take which is admirable. Of course, it is a beneficial policy: it means co-operation and mutual help, with all that that implies. Carried further, it results in local and trade associations, the development of statistics by the compilation of information from each, to form a condensed and averaged whole; central services on marketing and general trade influences; and many other helpful things. It is, indeed, the spirit of the times, and is one of the tendencies and policies which have made American industry so efficient.

Therefore exceptions are striking. They are rare, especially in the mining industry, but once in a while such an exception comes to our notice. They are more common in the East than in the West—in the East where time and tradition has bred more of a spirit of aloofness and self-sufficiency. Some companies—large and small, but mostly large—in the East, have adopted the principle of "No Publicity." Each of these companies represents, in its own mind, a closed system or circuit—what is outside doesn't count. They are, to be sure, willing to take what they can get from others, in the shape of information; they are willing to read authoritative articles, or listen to instructive and entertaining lectures; but they are opposed to letting their own men write or talk about company matters upon any occasion whatever.

Someone has hinted that tax persecution has led to the general policy of seeking obscurity, on the principle that whenever the state legislator has his attention called to an industry or corporation, his instant reaction is to tax it a little more: if this is the reason, it is unintelligently, since indiscriminately, applied—when it limits the exchange of scientific information and harmless and cheerful news.

We will not pursue the matter further by calling "right out in meeting" the names of the really estimable companies which prefer to work in secret: but it gives us pleasure to mention one or two examples of the opposite kind. Mr. Basil Prescott has just sent to us from Mexico an important article on "Replacement Deposits in Limestones," which we shall publish soon. In illustrating his subject, both by text and figures, he has freely drawn on the experience and on the mine maps of the American Smelting & Refining Co. and the American Metals Co., with the express permission of the companies in question. The experience at these mines, and the principles involved, have been of great use to these companies: and they are willing to share the information and the operating data with the rest of the mining world.

How to Mine Without Ore

MANY of the mining companies on the Comstock Lode, in Nevada, have found out how to mine without ore. Buying and selling the stock on the San Francisco exchange and levying perennial assessments to keep a watchman or so on the job is the formula. We present in Discussion a letter from an old-time mining man, in which, speaking of a portion of the Comstock Lode which was barren, he instances the Bullion, which he says operated for thirty years without shipping a carload of ore. Another correspondent writes us from San Francisco that he has looked up the records and finds that the Bullion "has levied and collected nearly $4,000,000 in assessments without ever producing any ore. It has been in practically continuous operation for sixty-five years and is one of the most thoroughly prospected mines on the Comstock Lode. In recent years, very little development work has been done, but the stock is still traded in on the Mining Exchange."

Mining engineers, in estimating the probable life of mines, have evidently missed an important factor. So far as we can see, there is no reason why a mine should not live forever. Mr. T. A. Rickard some years since wrote an editorial entitled "Even Methuselah Died," which presented the discouragingly unpopular theory that all mines pass away through exhaustion of the ore, sooner or later; but if there never was any ore, how can it be exhausted?

Organized Minorities

WE HEAR MUCH concerning the activities of organized minorities. Properly organized and engineered, it seems, they may circumvent and overcome the potentially powerful, but sleeping majorities. To such activity, it is claimed, certain legislation like the prohibition amendment is due.

Corporations, including mining companies, are very often dominated by such organized minorities, entrenched as officers and directors of the company. In many cases of large mining companies the members of the directorate have as a rule small permanent holdings—far less than some stockholders whose interest and opinion have no representation whatever. Such stockholders are ineffective because they lack organization. With all the devices for fairness and justice, it is as possible as ever in the history of the world for force, disguised as legal procedure, to win over considerations of impartial administration.

For such a condition the remedy is obscure, under our laws. The purchaser of stocks simply must beware —*caveat emptor;* he must take his chance on the officers and directors in control, who can make or break him, and over whose action he has no influence. Recently a

stockholder of a large mining company desired some knowledge of its affairs, but was slow in asking for it, feeling that his holdings were relatively small in proportion to those of the directors and officers. Happening to investigate this, he found that he held more stock than six of the directors together, and that of all the officers and directors he held more stock than any one individual except the president. Emboldened immeasurably by this, he wrote to the president and asked for an interview, receiving a reply that the president was preparing for a trip and could not spare the time.

The organized minority as a rule pays scant heed to the unorganized minority or majority. Control will always lie in the hands of the fixers and jobbers, unless there is thought and time expended in planning how to influence or control their methods.

Significance of Differential Flotation

THE PROBLEM of treating ores containing sulphides of lead, zinc, and iron in association with more or less gold and silver has vexed mill men, metallurgists, and smelter men. The mill men made substantial progress by the use of tables of the Wilfley type, which admitted of fairly good separation of the lead sulphide from the zinc and iron in ores in the treatment of which crushing moderately fine liberated the several minerals. Electromagnetic and electrostatic separators were successful in separating the zinc and iron sulphides. Commercial results were obtained, and many ores formerly marketed with difficulty, and then only with small or no profit, found an outlet. Where a more intimate association of the minerals was encountered results were not so good. Fine grinding was necessary to effect liberation of the several minerals, and the resulting pulps could not be handled satisfactorily on tables or by the magnetic separators.

The work at Trail on the Sullivan ores firmly established differential flotation as a means of dividing an ore of this nature into three or more parts—a lead concentrate containing some zinc, a zinc concentrate containing some lead, and an iron product containing both lead and zinc in small amounts. However, hydrometallurgical separation of the zinc and its deposition by electrolysis was an essential element in the successful treatment of the zinc product, and this process had been commercially developed before differential flotation became established.

The smelter man did not succeed in solving the problem of lead-zinc ores, for his only plan was to crowd the zinc into the slag, and this required a certain proportion of slag for a given amount of zinc. High zinc ores thus increased his smelting costs, and this was overcome by penalizing the zinc above a certain maximum. The more zinc that was offered the greater his difficulty became, and it is not to be wondered that he had little interest in such ores, although he bought them if high enough in gold and silver. As the easily smelted ores became scarcer the custom business suffered, and likewise did mining. The miner felt the penalties and high smelting costs severely. He produced several metals, but could realize on only part of them, and often only at prohibitive cost. Thus was a partial impasse created.

Differential flotation has dissipated the impasse by giving the smelter the high-grade lead-silver-gold material that he needed and by also providing marketable zinc concentrates. The building up of a custom flotation plant for the handling of miscellaneous lead-zinc-iron-gold-silver ores is an outgrowth of the last five years. The smelter man has been able to reduce his charges materially and to pay for a higher proportion of the lead. He is also able to handle a greater proportion of dry or siliceous ores and thus still further reduce costs. More metal is produced with fewer furnaces.

It is logical to expect to find the custom concentrator an adjunct to the custom smelter. Differential flotation is a tricky thing and requires close technical control. Without doubt, something could have been accomplished by independent mills at the mines, but this would have required capital expenditures and the maintenance of a larger technical staff. The smelter man sensed the advantage to him, and initiated the custom concentrator and along with this an interesting technical problem. Ores of the kind varied between wide limits. Variation in plant operation could have been accomplished, but would have been clumsy and uncertain. The method adopted is the making of a mixture of various ores in such proportion that a definite standard ore is maintained, or, as one smelter man put it, a synthetic ore is made and the operating rationale adjusted to handle this ore as efficiently as possible. This proved to be workable. Every advantage is taken of accessory reagents, zinc sulphate, cyanide, and copper sulphate. A considerable technique has been established.

Apparently everyone has benefited, but especially the miner, for he has found a profitable outlet for his ores and has added to his ore reserves. Railroad tonnage has been substantially increased, for the ores have to be brought to the plant and the zinc concentrates must be shipped away. More lead is produced and shipped, thus benefiting the railroads again. More zinc is produced, and this is hauled away by the railroads. Electrical power is consumed in depositing the zinc, and more labor in melting and handling it. Kilowatt-hours are locked up in the zinc and merchandised. It is therefore unnecessary to distribute the power by long transmission lines.

Two smelters, the International at Tooele and the United States Smelting, Refining & Mining Co.'s Midvale plant, have established customs concentrators in Utah and already have made substantial increases in their ore supplies by reason of the advantages they now offer to their customers. Both companies have substantially increased metal mining in the regions tributary to their plants, and therefore deserve the commendation of the mining industry.

Railroad Rates and Ore Reserves

A SKILLFUL MINER establishes his scale of working costs and classifies his ore accordingly. Ore that will pay is kept apart from that which is too low in grade to warrant removal. Ore which yields a good profit over extraction and marketing is also distinguished. Marketing costs and freight rates play an important part. Where these are high mine production may be so scaled down that costs are materially increased. Where they are low more ore is available and mined, thus lowering extraction costs and increasing reserves of profitable ore.

Both custom smelter and the railroad freight agent are important factors in determining this question of rate of mining and costs. In general, the lower the marketing costs the larger the tonnage and the greater the profit of both smelter man and railroad. With lower freight rates, lower smelting charges result where the tonnage factor is materially increased. The three parties to this triangle—miner, smelter, and railroad—have a mutual interest in the problem, and it behooves them to study it persistently and as business men concerned in maintaining a profitable flow of ore. Too often the miner has been allowed to struggle along alone. He almost lost out, but there is evidence of a broader interest in his struggle. The smelter that takes too large a profit per ton of ore is often directly curtailing its business. Likewise the railroad.

The comparatively recent development of custom concentrators for the application of differential flotation to complex ores has been a material factor in increasing ore tonnages, and this in turn has affected both smelting charges and railroad rates. The result has been a "spiralling down" of aggregate costs, to the great benefit of the individual miner and likewise of his two partners. The present need in this situation, favorable though it may be at the moment, is greater effort on the part of the miner to extend his development and increase his ore reserves, to the end that existing tonnages may be maintained and even increased.

A Belated Notice of Public Hearing

ON JUNE 17, 1926, the Department of the Interior issued the following notice for immediate release to the press:

"A public hearing on a petition for an adjustment downward of all royalties on oil and gas permits issued by the Government in San Juan County, Utah, will be held in the Interior Department on June 18, 1926, at 2 p.m."

While the notices were dated the 17th, they were not delivered in New York until June 19. This hearing was held at the request of holders of oil and gas leases in Utah, and represented by Salt Lake City attorneys. No doubt the attorneys must have been well on their way to attend this hearing when the notice to the public was issued. The public certainly had little chance to protest the proposed royalty reduction, and local land owners in San Juan County, 185 miles from the railroad, would be at least two weeks too late to file any brief in the case. What motive can be back of such a procedure in affairs in which the public is vitally interested? It is not even a legal notice, and yet it is issued by a great executive department at Washington, which should be a model in such affairs. This reminds one of the society matron who did not wish to offend any one, so to those that she hoped would stay away from her party by reason of other engagements she mailed invitations in time for delivery when her chosen guests were arriving.

That is not all. The notice says: "and present oral arguments." Why specifically call for oral arguments? This would indicate that written testimony in the form of briefs for permanent records is neither necessary nor desirable. There is too much "oral argument," and there are too many gentlemen's agreements in official Washington. Of course, in the oil tangle revealed by Senator Walsh a couple of years ago, absence of many details was a valuable asset to the holders of oil leases. This oral hearing, without opposing witnesses having a chance to attend, may in the future loom up as a spectre to haunt the department in the absence of written briefs. More time, please, when the next public hearing is held!

Use of Cubical Grinding Media

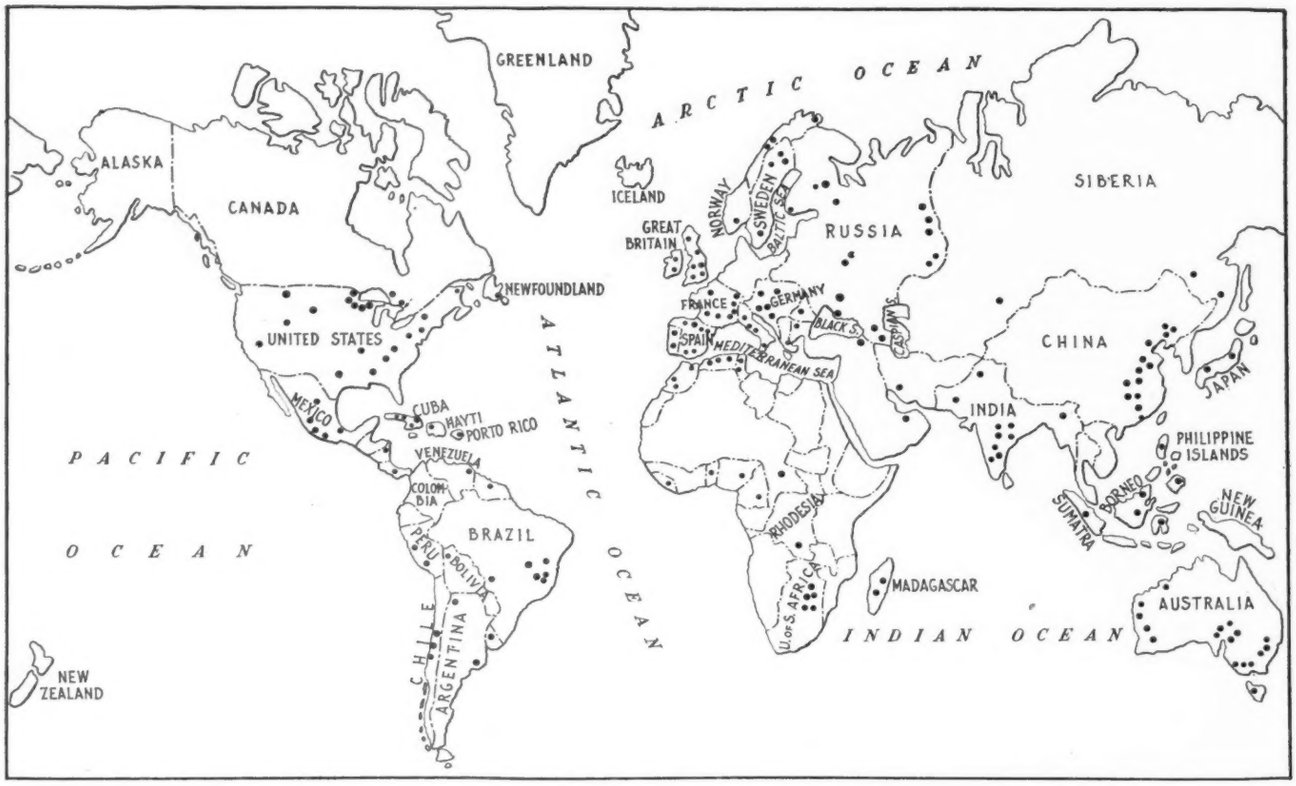
MUCH INTEREST was aroused by the article published in this journal about two years ago describing the work done at Nacozari wherein steel cubes were substituted for steel balls as grinding media in ball or rod mills. There were many inquiries for further details and for such "inside information" as could be obtained. The success of the experiments led others to consider the adoption of the cubes, though few plants have so far tried them, waiting until their efficacy had been more generally proved. Somewhat the same condition has obtained in the general attitude toward rubber linings for ball mills.

The article presented on pages 95 to 99 in this issue will throw further light on the principles underlying the use of grinding cubes and will no doubt renew interest in the matter, so it is worth mentioning here that cubical grinding media have been in constant service at the Nacozari concentrator of the Phelps Dodge Corporation, in from one to three of the secondary grinding rod mills, since their use was first commenced there in December, 1923. None of the other Phelps Dodge plants have adopted them; in fact, no special effort has been made to introduce cubical grinding media at other plants. At least one small plant, however, a number of miles south of Nacozari, has used the cubes regularly for a year or two, and the local management is enthusiastic in praise of the results obtained. The innovation would seem worthy of further trial.

Petroleum Research

TWENTY-ONE PROJECTS in fundamental research in the geology, physics, and chemistry of petroleum have been recommended to the American Petroleum Institute by the National Research Council. In turn, through one of its bulletins, the Institute has submitted them to all persons within or without the industry for suggestions and criticisms. Five of these projects concern the geology of petroleum, the topics being: the generation of oil in rocks by shearing pressures; experiments in the artificial carbonization of carbonaceous rocks by geophysical methods; studies of source rocks in the micro-furnace; origin and environment of source sediments; and, the critical study of selected source beds.

It was at the request of the Institute that the Research Council made these recommendations. The first-mentioned body has two gifts of money with which to finance the work. Each of these amounts to $50,000 a year for five years, one being donated by John D. Rockefeller and the other by the Universal Oil Products Co. No similar announcement has hitherto been made by the Institute. The plan it is pursuing in deciding how best to spend this money is a wise one and will insure the selection of those problems for study which most need to be solved at the present time. Announcement of the personnel recommended in various institutions has been deferred until the Institute has taken final action.



Sketch map of the world, showing location of iron ore deposits

World's Iron-Ore Resources Now Exceed 57,000,000,000 Tons

New Deposits Found in Last Ten Years and Additional Tonnages Developed in Those Already Known Make Total Greater Than Previously Estimated

By Olin R. Kuhn
Donner Steel Co., Buffalo, N. Y.

SINCE THE LAST ESTIMATES of the iron-ore reserves of the world were made, five or ten years ago, several new deposits have been discovered and some of the old deposits have been further explored and have been shown to contain large additional tonnages. During the last few years, moreover, great progress has been made in the beneficiation of low-grade ores hitherto considered unsuitable for existing furnace practice, making available large tonnages of these ores. A few years ago the actual iron-ore reserve of the world was estimated at between thirty and thirty-five billion tons. Today it can be put at from fifty-five to sixty billion tons, with great possibility of a further increase in the future.

The results of the survey of the iron-ore reserves of Great Britain and her possessions made during the last ten years were published about two years ago and showed much more available ore than was known before. Surveys made recently in Sweden, China, the United States, and in many countries of Europe also show reserves far greater than were previously known. Should one try to give a detailed description of the various deposits throughout the world, several volumes would be required. I will therefore give simply an outline of the reserve tonnage and the approximate grades of ore found in each country. These figures are thought to be as accurate as any obtainable at the present time.

United States.—The United States of America has long been noted for its large deposits of high-grade iron ore and its enormous production. The Lake Superior region is probably the most noted iron-ore field in the world, and from it comes 50 per cent of the world's iron-ore output. Practically all grades of ore are found on the six large ranges that comprise the Lake Superior district, but the greater part of the ore is hematite averaging 55 to 60 per cent in iron. Mining is carried on by open pits, milling, and underground methods, and some of the largest mines in the world are found in this region. R. C. Allen estimates the actual reserves of the Lake Superior district at about 2,650,000,000 tons. Potential or possible reserves of low-grade ores and taconite can be put at about 72,000,000,000 tons. At the rate at which the high-grade ores are being mined in the district they will probably be exhausted in about thirty years, but many of the lower-grade ores can be beneficiated to make desirable furnace material.

The Northeastern States district includes the states of New York, New Jersey, Pennsylvania, Ohio, and Indiana. The largest field in this district is the

Adirondack region in New York State, which is estimated by F. S. Witherbee to contain about 2,500,000,000 tons of ore. The ore is magnetite and Clinton hematite, and although some of it is of high grade, carrying 55 to 65 per cent of iron, much of the tonnage is of low grade and will have to be concentrated. Magnetite ores are also found in New Jersey and Pennsylvania and carbonate ores occur in Ohio, Indiana, and Pennsylvania. The reserve of the Northeastern States district can be taken at about 3,130,000,000 tons of ore averaging 35 per cent or better in iron content.

The Western States region includes the Rocky Mountains and Pacific Coast states, and has been less explored than the other regions. No large tonnages have been discovered in this area as in the other districts, although with further prospecting it is quite probable that some large orebodies may be found. The largest reserves known at present are in the Great Falls district in Montana, which are estimated to contain about 300,000,000 tons of hematite ore averaging 65 per cent in iron. California is estimated to have a reserve of about 200,000,000 tons of hematite ore and Utah between

Analyses of Iron Ores From Various Countries

Country	Ore	District	Analysis—Dry: Iron	P	Sil.	S	Lime	Alum.	Mang.	CO_2	H_2O
United States	Republic	Superior	62.50	0.06	7.50	0.018	0.20	1.50	0.07	....	1.25
	Richmond	Superior	39.20	.04	40.70	.009	.50	1.15	.12	....	2.82
	Sagamore	Superior	44.00	.28	5.00	.011	.95	5.00	10.00	....	15.00
	Mahoning	Superior	64.00	.04	2.80	.013	.15	1.50	.30	....	9.85
	Harmony	Adirondacks	62.65	.09	10.62	Tr.	1.20	1.30	.03	....	1.00
	Cornwall	Pennsylvania	51.54	....	11.68	2.41	2.74	3.51	....	....	....
	Wenonah	Birmingham	37.10	.36	13.20	....	16.00	3.05	....	....	1.00
	Giles	Birmingham	50.40	.31	13.42	....	....	2.40	....	....	5.40
	Brown Ore	Texas	46.63	.17	14.46	.080	....	8.17	....	....	....
	Great Falls	Montana	64.76	....	4.83	....	....	....	....	....	....
Newfoundland	Wabana	Bell Island	53.86	.85	9.50	.018	1.80	3.55	.65	4.32	4.32
Canada	Magpie	Ontario	58.20	.13	4.40	.127	.23	.88	.17	....	5.70
Mexico	Las Truchas	Michoacan	63.92	.05	5.98	.027	.50	.55	.03	....	2.00
Cuba	Mayari	Mayari	46.00	.10	5.50	.060	Cr. 1.70	10.33	.56	Ni. .05	45.26
	Daiquiri	Oriente	63.10	.03	7.20	.100	1.00	....	.10	....	....
Porto Rico	Mayaguez	Mayaguez	41.00	....	2.40	....	Cr. 1.60	20.20	....	Ni. 1.0	15.00
Brazil	Minas Geraes	Minas Geraes	68.20	.05	1.00	.020	.10	.60	.30	....	2.00
Chile	Tofo	Coquimbo	67.50	.03	2.50	.010	....	....	.20	....	....
Venezuela	Colon	Piacoa	59.37	.19	7.25	.072	....	....	.07	....	....
Great Britain	Jurassic	Northampton	38.20	.70	17.40	.120	3.10	7.20	.30	....	15.20
	Red Mines	Stafford	33.00	....	3.00	....	3.50	....	....	41.00	....
	Barrow	Cumberland	52.30	.007	11.00	....	....	....	....	....	5.45
Norway	Concentrating	Sydvaranger	36.00	.085	44.00	.030	2.50	.80	....	....	....
Sweden	Class "C"	Kiirunavaara	67.70	.26	2.10	.017	.90	.60	....	....	.80
Russia	Krivoi Rog	S. Russia	68.50	.02	1.55	.080	....	....	.06	....	....
	Gora Blagodat	Urals	53.90	.25	9.40	.050	6.00	7.18	....	....	.20
Belgium	Rich Ore	Namur-Liege	45.00	.48	11.00	.150	4.80	7.00	.13	7.00	....
France	Yellow Bed	Lorraine	38.00	.30	7.50	....	9.80	4.20	....	....	14.00
	St. Remy	Normandy	53.20	1.03	7.85	.050	.42	2.97	.26	....	....
	Segre	Anjou	54.00	2.10	11.00	....	....	....	.25	....	....
Spain	Rubio	Bilbao	53.17	.02	11.16	.035	....	....	....	....	7.56
	Cehegin	Murcia	56.00	.15	8.00	.260	....	....	.30	....	....
Portugal	Monges	Serra dos Monges	54.00	.01	6.50	....	....	....	....	....	....
Switzerland	Fricktal	Aargau	35.00	.40	12.80	.030	9.00	6.00	.02	10.00	....
Jugoslavia	Pizitsi	Vares	61.20	.06	6.05	.160	.35	.70	.11	....	....
Austria	Erzberg	Styria	38.73	.02	4.10	.080	5.90	1.26	2.45	27.60	....
Czechoslovakia	Iglo Mine	Ruthenia	39.43	Tr.	11.00	.350	....	....	.20	31.50	....
Algeria	Djebel	Algiers	54.16	.08	3.63	.013	4.30	1.30	1.35	....	....
	Benisaf	Oran	50.00	.03	5.00	.040	5.50	....	1.00	....	....
Tunisia	Djerissa	Djerissa	55.00	.01	1.35	.008	4.13	....	2.32	....	....
Morocco	Navarete	Melilla	54.00	.03	11.00	.100	2.00	....	.50	....	....
French Togoland	Banyeli	Sokode-Bassari	50.00	.02	9.47	Tr.	Tr.	.24	.10	....	....
Transvaal	Pretoria	Pretoria	54.00	....	14.00	....	....	6.00	....	....	....
India	High Grade	Mysore	64.24	.03	1.12	.038	....	2.36	.10	....	....
China	An-shan	Fengtien	38.17	.03	43.72	.011	.62	.34	....	....	....
	Ssu-chia-Ying	Chihli	28.70	.03	53.80	.060	....	....	....	....	....
	Ta-Yeh	Hupei	61.00	.10	4.00	.08	.30	12.50	.30	....	....
Japan	Kamichuku	Fukushima	64.02	.01	8.50	.015	....	....	....	....	....
	Asagisni	Iwate	62.62	.06	36.43	Tr.	....	....	1.00	....	....
Australia	Iron Knob	South Australia	68.70	.02	.76	.050	....	.26	....	....	....
	Koolan Island	West Australia	64.91	.01	7.06	.040	....	....	....	....	....
	Cadia	New South Wales	61.30	.05	9.22	.099	....	....	....	....	....
	Mount Leviathan	Queensland	56.50	.08	17.00	.050	....	1.40	....	....	....
New Zealand	Washburn	Parapara	51.38	.15	9.56	.080	....	3.36	....	....	....
	North Plymouth	North Island	56.87	.39	3.90	.004	....	4.00	TiO_2 9.20	....	....
Dutch East Indies	Seboekoe	Borneo	53.09	.06	2.75	.210	Cr. 2.30	....	.43	....	....

The Southern States district includes all of the area south of Pennsylvania and east of eastern Texas. The Birmingham and Alabama ore fields are by far the largest in this region, although the ore is generally Clinton hematite carrying 35 to 40 per cent iron. In Alabama the iron-bearing area is estimated to contain 1,700,000,000 tons of Clinton and brown ores. The Chattanooga district contains about 750,000,000 tons of the same type of ores, and the Virginia-Tennessee district about an equal amount. Texas is credited with 750,000,000 tons of brown limonite ore, and Missouri, the only other large district, with 75,000,000 tons of hard hematite and limonite ore. Total reserves of the Southern States are estimated at 4,040,000,000 tons of available ore. It is believed, in addition, there exists in the area about 10,710,000,000 tons of possible[1] ore.

[1]The term "actual" is used where the ore is already proven or where explorations show that in all probability it exists and can be mined. The term "possible" is used for low-grade ores such as the taconites on the Lake Superior ranges that are not available at present, but will be used in the future—ore that is not proven but the existence of which is indicated by the formation, and ore that cannot be mined or used under present conditions and methods. Many ores that a few years ago were not considered as available can now be beneficiated and used, and in the future new methods of beneficiation will probably be discovered that will make ores available that are now useless.

80,000,000 and 100,000,000 tons of hematite and magnetite. The total reserve of the Western States can be taken at 630,000,000 tons of actual ore, and 1,000,000,000 tons of possible ore.

Total reserves of the United States are estimated at 10,450,000,000 tons of actual ore averaging about 50 per cent in iron, and 83,870,000,000 tons of possible ore carrying about 25 to 30 per cent of iron.

Newfoundland.—Probably the largest body of iron ore in the world for the area it covers is found in Newfoundland, on Bell Island, in Conception Bay. The ore outcrops on Bell Island, which is about 6 miles long by 2 miles wide, and extends out under the waters of the bay. It is known as Wabana, and is a red hematite carrying from 48 to 57 per cent iron. It is estimated that the Wabana deposits contain about 4,000,000,000 tons of actual ore and an equal amount of possible ore.

Canada.—Comparatively little exploration has been carried on for iron ore in Canada, and, although a few fairly large deposits are known, only 200,000 to 300,000 tons is mined annually. The Moose Mountain deposit in Ontario is the largest known in the Dominion and contains about 100,000,000 tons of magnetite ore. The

greater part, about 80 per cent, of the iron ores of Canada are low-grade magnetite and siderite, and it is estimated that the total reserve available is only about 300,000,000 tons. The possible reserve of low-grade ore and taconite is put at 20,000,000,000 tons.

Mexico.—Most of the larger deposits of iron ore in Mexico are situated on the west coast, the largest being those of Cerro del Mercado, Las Truchas, and El Mamey, which are estimated to contain about 300,000,000 tons of high-grade hematite ore carrying over 60 per cent iron and which can be operated by open-pit mining.

Central America.—A deposit of magnetite ore at Pis Pis, in Nicaragua, which runs 65 per cent iron, is estimated to contain about 25,000,000 tons, and another near the Chorcha Mountains, in Panama, is said to contain an equal amount.

Large Reserves in Cuba

Cuba.—There are five districts of soft, brown hematite ore in Cuba (Mayari, Levisa, and Moa, in Oriente Province; San Felipe, in Camaguey Province, and Pinar del Rio), and one of hard or magnetite ore (Daiquiri, Oriente Province). The Moa deposit is the largest and contains almost two billion tons of available ore; the Mayari deposit contains about 600,000,000 tons, the Levisa 75,000,000 tons, the San Felipe 450,000,000 tons, the Pinar del Rio 40,000,000 tons, and the Daiquiri about 9,000,000 tons. More than 90 per cent of the iron-ore reserve of Cuba, which is estimated at 3,160,000,000 tons, is controlled by steel companies in the United States. The soft ore in Cuba contains from 25 to 35 per cent of moisture and is dried and nodulized before being shipped. The possible reserve of Cuba is put at 12,000,000,000 tons.

Hayti and Porto Rico.—A large deposit of magnetite ore is known to occur in the Dominican Republic (Island of Hayti), which is said to contain about 41,000,000 tons, but little exploration has been done. There is also a large deposit of limonite ore at Mayaguez, in Porto Rico, which averages 40 per cent in iron and which is estimated to contain 430,000,000 tons.

South America's Reserve Over Eight Billion Tons

Brazil.—The iron-ore deposits in Minas Geraes, in Brazil, are estimated to contain about 3,500,000,000 tons of hematite ore averaging 63 to 69 per cent iron, most of which can be mined by quarrying. Other deposits are known in the states of Bahia and Matto Grosso, which are said to contain an equal amount, so that the total reserve of Brazil can be put at 7,000,000,000 tons of high-grade ore. These deposits are owned by British, German, French, Brazilian, and American capital, but to date there has been practically no development.

Chile.—The iron-ore reserves of Chile are quite large, but few ore-bearing areas have been properly explored. The Tofo mines, in the province of Coquimbo, are the only ones now in operation. These are owned by the Bethlehem Steel Co., and the ore is shipped to the company's furnaces in the United States. The ore is a high-grade hematite averaging 67.50 per cent iron, and the deposit contains about 200,000,000 tons of ore. This ore is all mined by quarrying. At Algarrobo, in the Province of Atacama, there is a body of hematite ore averaging 68 per cent iron and containing about 200,000,000 tons of probable ore. The total reserve of Chile has been estimated at 440,000,000 tons.

Peru.—Little attempt to develop the iron ores of Peru has been made, but a large deposit is known to exist at Marcona, in the Department of Ica, which is said to contain 500,000,000 tons of hematite ore carrying 60 to 65 per cent iron. At Huacravilca, in the Province of Huancayo, there is an important deposit of hematite ore which averages 67 to 70 per cent iron. This is estimated to contain about 64,000,000 tons of ore exposed. There are several other deposits in Peru, but little is known about them, and the total reserve can be put at 564,000,000 tons.

Dutch Guiana.—A large deposit of laterite ore, which is said to contain about 100,000,000 tons running 43 to 60 per cent in iron and high in alumina, has recently been discovered in Dutch Guiana at Donderbary.

Uruguay.—Iron-ore deposits have been reported in many parts of Uruguay, but the only one that has been developed or about which anything is known is at Zapucay, in the Department of Rivera. It is estimated to contain 80,000,000 tons of manganiferous ore averaging 35 per cent iron and 23 per cent manganese.

Venezuela.—The most noted deposit of iron ore in Venezuela is the Imataca deposit, at Manoa, which is credited with about 10,000,000 tons of magnetite ore averaging 66.50 per cent iron. The Colon iron mines, at Piacoa, are estimated to contain about 5,000,000 tons of hematite ore carrying from 50 to 60 per cent iron. As far as is known, the total actual reserve of Venezuela is only about 15,000,000 tons.

Europe—Sweden's Large Reserve of High-Grade Magnetite

Great Britain.—Iron ore is found in practically all parts of Great Britain, and, although the reserve tonnage is enormous, it is generally composed of low-grade Jurassic or carbonate ores, which in many cases have to be beneficiated before they are of commercial value. The largest fields are in Northampton, which are estimated to contain 1,654,000,000 tons of Jurassic ore averaging about 33 per cent in iron. Other large beds of Jurassic ore are found in Lincolnshire, Yorkshire, Oxford, and Warwick. The largest bodies of carbonate ore are found in Staffordshire, where the reserve is put at 1,302,200,000 tons of 35 per cent ore. Derby and Scotland also contain large deposits of carbonate ore. Deposits of hematite are found in Cumberland and Lancashire, but these are small and relatively unimportant. The total reserve of Great Britain is estimated at 5,969,600,000 tons of actual ore and about 6,198,700,000 tons of possible ore.

Norway.—Iron-ore reserves of Norway are large, and, although the ore is magnetite, it is generally low grade and requires concentrating. The deposits at Sydvaranger and Dunderland are said to contain about 265,000,000 tons of hematite and magnetite ore carrying from 35 to 37 per cent iron. Concentrates produced from these ores run 65 to 68 per cent in iron. The total reserve of the concentrating ores of Norway can be put at about 325,000,000 tons of actual ore, most of which can be mined by open pits, and 1,255,000,000 tons of possible ore. Direct-smelting ores, carrying from 40 to 50 per cent of iron, are found in various parts of Norway, but the reserve is estimated at only 12,500,000 tons of actual ore and 55,000,000 tons of possible ore. The total reserve of Norway can be taken at 383,500,000 tons of actual ore and about 1,347,000,000 tons of possible ore.

Sweden.—For centuries Sweden has been famous as a producer of iron ore, and that country probably contains one of the largest reserves of high-grade mag-

netite ore in the world. The largest deposits are in northern Sweden, and the ore averages 60 to 70 per cent in iron and is remarkably pure. The largest deposit at Kirunavaara is virtually a mountain of iron, and is estimated to contain 1,500,000,000 tons. Other fairly large deposits in northern Sweden are found at Luossavaara, Gellivaara, Koskulls-Kulle, Leveaniemi, Mertainen, and Ekstromsberg. Total reserves of these districts are estimated at 2,018,350,000 tons of actual ore and 500,000,000 tons of possible ore. The reserve of central Sweden is not as large, and the orebodies contain some hematite. The largest deposits are found at Grangesberg and Donnemora, and the ore carries from 50 to 60 per cent iron. Reserves of central Sweden can be taken at 185,000,000 tons. The total reserve is estimated at 2,203,350,000 tons of actual ore and about 674,000,000 tons of possible ore.

Finland.—As yet the iron ores of Finland have not been important, on account of the size of the deposits and the low grade of the ore. The Jussaro deposit is estimated to contain about 30,000,000 tons of low-grade magnetite ore carrying only 26 per cent iron, which will have to be concentrated before it is of commercial value. The Pitkaranta deposit contains 13,500,000 tons of ore averaging 38 per cent iron, but it is quite high in sulphur. Actual iron-ore reserves of Finland are about 43,500,000 tons.

Russia.—Russia contains a considerable reserve of iron ore, which will probably be increased on further exploration. Large deposits of hematite ore are found at Krivoi Rog and at Kertch, in southern Russia, which are estimated to contain about 900,000,000 tons of ore averaging from 40 to 70 per cent iron. In central Russia there is a deposit of brown and spathic ore in Vladimir, which is said to contain 100,000,000 tons of 40 per cent ore. and a deposit of brown hematite ore at Lipetsk which contains 700,000,000 tons of ore carrying 52 per cent of iron. Deposits of hematite and magnetite are scattered through the Ural Mountains, the largest being at Alapaievsk, Perm, and Viatka. The deposits at Perm and Viatka are low-grade siderite carrying only 22 per cent iron, but the other deposits average 45 to 65 per cent iron. Total reserves of the Ural Mountains are estimated at 500,000,000 tons. A deposit of high-grade ore has been found at Daschkiessan, in the Caucasus, which is said to contain about 20,000,000 tons of 62 per cent ore. The total reserve of Russia is estimated at 2,235,000,000 tons of actual ore and about 617,000,000 tons of possible ore.

Germany.—Germany's reserve of iron ore was greatly reduced by the loss of the Lorraine ore fields, so that now it is put at only 1,317,000,000 tons of actual ore with a possible 2,843,000,000 tons additional. The largest known deposits are in the East Rhine district at Siegerland, Dill, Lahn, and Vogelsberg, and the ore is siderite and hematite carrying 25 to 48 per cent iron. Reserves of this district are estimated at 453,750,000 tons of actual ore and 172,500,000 tons of possible ore. The largest deposit in the Wesser district is at Salzgittern, and is estimated to contain 278,000,000 tons of actual brown ore carrying 30 per cent of iron with a possible reserve of one billion tons. Ores of the Wesser district are low-grade brown hematites which carry only 18 to 33 per cent of iron. Total reserve is put at 439,100,000 tons of actual ore and 1,457,000,000 tons of possible ore. Deposits of brown ore containing 50 to 55 per cent of iron occur in Bavaria, and large bodies of low-grade siliceous ore analyzing 39 per cent iron are found in Württemberg. The Bavaria-Württemberg deposits are said to contain 292,000,000 tons of actual ore and 1,100,000,000 tons of possible ore. Deposits of chamosite running 30 per cent iron occur in Thuringia which are said to contain about 104,300,000 tons of available ore. Bog ores occur in northern and central Germany and some brown ore is found in the West Rhine district, but the deposits are fairly small.

Luxemburg.—A part of the Lorraine basin extends into Luxemburg. The ore is an oölitic brown variety containing about 30 per cent iron—quite similar to the Lorraine ores. The reserve is put at 270,000,000 tons.

Belgium.—Most of the ore being mined in Belgium at present comes from the Campine district. Here the ore is a high-phosphorus brown variety containing 30 to 35 per cent iron. The reserve is put at about 15,000,000 tons. Bedded hematites occur in the Namur-Liége district which carry 25 to 45 per cent iron. The reserve is estimated at 50,000,000 tons of available ore and 66,000,000 tons of possible ore. Some ore is found in central and southern Belgium and in the Lorraine field in Belgium, but the reserves are small. The total reserve of Belgium is estimated at 70,000,000 tons of available ore.

France.—The iron-ore reserves of France have been greatly increased by the acquisition of the Lorraine Annex, and now France has virtually a monopoly of the iron-mining industry of Continental Europe. Of course, the largest iron-ore district in France is the Lorraine field, which is estimated to contain over six billion tons of minette or oölitic limonite ore, carrying 25 to 45 per cent iron, most of which is mined by open pits. Production of this field is about 30,000,000 to 40,000,000 tons annually. Large beds of carbonate ore averaging 40 to 48 per cent iron occur in Normandy, and the reserve here is put at 1,275,000,000 tons of actual ore. Reserves for the Normandy district have been estimated at as high as five billion tons, but such figures are probably exaggerated, although it is possible that the reserve is two billion tons more than the above-stated amount of actual ore. The Brittany and Anjou fields are south of the Normandy field, and contain hematite, magnetite, brown, and siderite ores averaging 46 to 54 per cent iron. The reserve of these fields is estimated at 750,000,000 tons of actual ore. There is about 60,000,000 tons of hematite and carbonate ore carrying over 50 per cent iron in the Pyrenees-Orientals district. Total reserves of France are estimated at 8,164,350,000 tons of actual ore with about 4,090,000,000 tons possible ore besides.

Spain.—One of the largest reserves of bessemer ore known is found in Spain. The country has been an important producer of iron ore for more than 2,000 years, most of which has been exported. Deposits of iron ore are widely scattered, although those in the northern part of the country and in the Sierra Morena are the largest. The Cantabrian-Cordillera district includes the provinces of Lugo, Leon, Oviedo, Santander, and Vizcaya and contains about 451,000,000 tons of actual ore. Practically all types of ore are found here, the iron content varying from 30 to 50 per cent. The Sierra Morena district includes the provinces of Huelva and Seville and contains about 360,000,000 tons of magnetite and brown bessemer ore carrying 47 to 50 per cent iron. The provinces of Guipuzcoa, Navarra, Huesca, Lerida, and Gerona are in the Pyrenees district, and the ores are usually brown hematite and magnetite

containing 57 to 68 per cent iron, but the reserve is put at only 12,000,000 tons. Saragossa Province, west of the Ebro River, is said to contain 34,000,000 tons of hematite ore carrying 60 per cent iron. The Sierra Monera deposits, the oldest in Spain, are estimated to contain still about 130,000,000 tons of hematite and spathic ores averaging 54 per cent iron, and the Sierra Fregenal district has 7,000,000 tons of hematite and magnetite ore running 55 to 66 per cent iron. The ranges of the south coast include the provinces of Malaga, Granada, Almeria, and Murcia and are among the largest producers in the country. The ore, which is brown hematite and magnetite, averages 50 to 60 per cent in iron and often contains manganese. Reserves of these provinces are estimated at 121,500,000 tons of actual ore. The country's total reserve can be put at 1,115,500,000 tons of actual ore and about 273,000,000 tons of possible ore.

Portugal.—The iron-ore deposits of Portugal are not of great importance at present, although they contain a total of 50,000,000 tons of available ore. Moncorvo deposit, in the Tras-os-Montes district, is the largest, containing 20,000,000 tons of hematite and magnetite ore, running 35 to 55 per cent iron. The Serra dos Monges deposit is said to contain about 17,000,000 tons of magnetite and brown ore averaging 48 to 55 per cent iron. The Sao Thiago de Cacem deposit contains 10,000,000 tons and the Porto de Moz about 3,000,000 tons.

Switzerland.—In the Canton of Aurgau is the recently discovered Fricktal deposit, the largest body of iron ore in Switzerland. This orebody contains about 15,000,000 tons of limonite ore running 25 to 35 per cent iron and high in silica. Total reserves of Switzerland are estimated at only 18,500,000 tons of actual ore and 26,500,000 tons of possible ore.

Italy.—No very large deposits of iron ore have been discovered in Italy, although all types of ore are found in the various scattered deposits. The most prominent deposits are on the Island of Elba, in Piedmont and Sardinia, and the iron content of the ores varies from 40 to 60 per cent. The actual reserve of Italy is only 18,300,000 tons.

Greece.—The principal occurrences of iron ore in Greece are near Lake Kopais and on the Islands of Euboea and Skyros. The ore is generally hematite carrying from 46 to 52 per cent iron, and the reserve is estimated at 80,000,000 tons of available ore.

Jugo-Slavia.—The Vares district, in Bosnia, is the only iron-ore deposit in Jugo-Slavia of economic importance, although the ore is generally low-grade hematite and limonite carrying 40 to 60 per cent iron. Reserves of the Vares district are put at 41,000,000 tons. There is a deposit of high-grade limonite ore at Ljubia, in Bosnia, and one of brown ore at Majdanpek, in Serbia, but they are fairly small. The total reserve of Jugo-Slavia is estimated at 46,500,000 tons.

Rumania.—There are two deposits of iron ore in Rumania, one at Banat, which contains 8,000,000 tons of hematite and limonite ore running 50 to 65 per cent iron, and the other at Hunyad, which contains about 17,000,000 tons of brown and spathic ore averaging 35 to 45 per cent iron.

Poland.—Several large deposits of low-grade spathic iron ore are found in the Czenstochau district in Poland, which are estimated to contain about 182,500,000 tons of ore varying from 30 to 35 per cent in iron. Deposits of bog ore are found near Warsaw and Kalisch, but the reserve is put at only 4,000,000 tons.

Bulgaria.—Deposits of iron ore in Bulgaria are small and of only local importance. The ores are magnetite and hematite averaging about 50 per cent in iron. Reserve is estimated at only 1,450,000 tons.

Austria.—A mountain of low-grade siderite ore is found at Erzberg, in Styria, which is estimated to contain 228,000,000 tons of ore averaging 38.73 per cent iron. This ore is calcined before it is used, and the calcined product averages 50.68 per cent in iron. At Huttenberg, in Carinthia, there is a deposit of limonite ore containing 43 to 49 per cent iron, but the reserve is put at only 14,000,000 tons.

Czechoslovakia.—Iron-ore reserves of Czechoslovakia are fairly large, but the ore is generally a low-grade brown or spathic variety containing 32 to 50 per cent iron. The largest deposits are in Bohemia, which are said to contain about 257,000,000 tons of brown ore requiring calcination. The reserve of Ruthenia is put at 73,800,000 tons and that of Moravia at 4,600,000 tons. Total reserves of Czechoslovakia are estimated at 336,400,000 tons of actual ore and about 201,000,000 tons of possible ore.

ALGERIAN DEPOSITS LARGE

Algeria.—Outside of the Union of South Africa, Algeria contains probably the largest known reserve of iron ore in Africa. Algeria is divided into three departments, in all of which ore is found along the coast of the Mediterranean Sea. As a rule, the ore is a fairly high grade of red or brown hematite containing 46 to 60 per cent of iron. The actual reserve is estimated at about 100,000,000 tons. The Department of Constantine alone is said to contain 60,000,000 tons.

Tunisia.—There are several deposits of iron ore in Tunisia along the Mediterranean coast and the border of Algeria which contain an actual reserve of 88,500,000 tons of hematite ore. The Gafsa deposit is the largest, containing about 60,000,000 tons of 52 per cent ore, and the Djerissa deposit contains about 20,000,000 tons of 55 per cent ore. Production of the country is about 500,000 tons annually.

Morocco.—A large deposit of hematite ore is worked in the Melilla district, in Spanish Morocco, not far from the coast. It is estimated to contain about 30,000,000 tons of ore averaging 50 to 62 per cent iron. Four mines are now operating in this district.

Togoland.—In French Togoland, in West Africa, there is an important deposit of hematite ore which is said to contain at least 20,000,000 tons of ore averaging 50 per cent iron. It is not being operated at present.

British West Africa.—A deposit of laterite ore occurs near Devil Hole, in Sierra Leone. It is estimated to contain over 3,000,000 tons of ore averaging about 60 per cent iron. There are also several deposits of titaniferous and laterite ore running 45 to 50 per cent iron, but data regarding the reserve are lacking. An important deposit of limonite ore is reported from Mount Patti, in Nigeria, which contains 32 to 56 per cent iron, and although the reserve is estimated at about 2,000,000,000 tons, it is not proven and can only be taken as a possible reserve.

British East Africa.—Deposits of hematite and magnetite ore have been found in Nyasaland, but little is known of the amount of ore that they contain.

Madagascar.—The Island of Madagascar, off South Africa, contains several large deposits of magnetite ore carrying about 65 per cent of iron. One of these in the Ambatolaona region has, it is estimated, about 4,000,-

000 tons, and one in the Betsiriry district 3,500,000 tons. The total reserve of the island, although probably much larger, can be placed at 7,500,000 tons.

South Africa.—The Transvaal, in the Union of South Africa, contains the largest reserve of iron ore known in Africa. There are two deposits which are quite large, one at Pretoria and the other at Potchefshoek. The Pretoria deposit contains about 400,000,000 tons of oölitic siliceous ore, carrying 44 to 54 per cent iron and 14 to 35 per cent silica, and the reserve of the Potchefshoek district is put at 600,000,000 tons of similar ore. There is also a deposit of titaniferous ore at Magnet Heights, which is said to contain about 24,000,000 tons of 60 per cent ore. The possible reserve of this type of ore in the Transvaal is estimated by Wagner to be about two billion tons. Deposits of hematite ore are reported at Buffelshoek, which are estimated to contain 50,000,000 tons of 64 to 68 per cent ore, and smaller deposits are found at Buckwood, Kromdraai, and East Transvaal, which contain about 20,000,000 tons. Total reserves of the Transvaal can be put at 1,094,000,000 tons of actual ore and 2,000,000,000 tons of possible ore. Several small deposits of limonite ore occur in Natal, but the total reserve is estimated at only 1,135,000 tons of ore averaging 45 to 55 per cent iron.

Rhodesia.—An enormous area of lateritic ore is reported near Lake Bangweolo, in northern Rhodesia, which is said to contain about 6,000,000,000 tons of ore. The ore, however, is low grade and very siliceous, and, as the reserve is not proven, it can be listed as a possible reserve only. Deposits of limonite and hematite are reported in southern Rhodesia, but no details of the reserve are available.

The reserve of iron ore in Africa is controlled by three countries, Great Britain, France, and Spain; Great Britain controls about 90 per cent of the known reserve.

Transcaucasia.—Although there is no iron industry in Transcaucasia, a deposit of magnetite ore has been reported near Dashkesan, which is estimated to contain about 2,000,000 tons of ore, and one of hematite ore at Tchatakh, which is said to contain about 800,000 tons. The total reserve of Transcaucasia is estimated at 13,000,000 tons of 54 per cent ore.

Persia.—The iron-ore deposits in Persia are small and of only local importance. Total reserves are 750,000 tons of 65 per cent hematite ore.

India.—Although the history of iron in India dates back to 1777, the industry underwent little development until recently. Within the last ten years it has made rapid strides, and at present several modern furnaces and steel plants are in operation. The largest known reserves of iron ore are in the provinces of Bengal, Bihar, and Orissa. In these provinces the ore is generally a high-grade hematite carrying 60 to 69 per cent iron, and the total reserve is estimated at 3,049,000,000 tons of actual ore, 3,000,000,000 tons of which are in the Singhbhum district. In the Central Provinces, hematite ores occur in Drug, Jubbulpore, and Chanda, averaging 61 to 71 per cent in iron. The reserve of these provinces is placed at 76,500,000 tons of known ore. In the Mysore province two large bodies of ore occur at Bababudan and Channagiri. The ore is high-grade hematite running 55 to 65 per cent in iron, and the reserve is estimated at 200,000,000 tons of actual ore, with a possible additional reserve of 500,000,000 tons. The total reserve of India, as far as is known, is about 3,326,000,000 tons of actual ore and over 20,000,000,000 tons of possible ore. Mr. Perin, consulting engineer of the Tata Iron & Steel Co., in India, states that there is more than 20,000,000,000 tons of high-grade ore in that country.

China.—During the last ten years an extensive study of the iron-ore resources of the country was made by the Chinese Government. The figures show that China can no longer be regarded as a storehouse of inexhaustible future supplies of iron ore, to be drawn upon by other nations. On the contrary, her reserves are estimated at less than one billion tons, and of this probably 50 per cent is controlled by the Japanese. Largest reserves are in the Province of Fengtien, which is estimated to contain about 760,000,000 tons of known ore and 300,000,000 tons of possible ore. The ore is hematite and magnetite, and practically all of it is low grade, carrying 30 to 40 per cent iron, which must be concentrated before it is desirable for furnace use. The Province of Chihli contains 78,160,000 tons of actual hematite and magnetite ore, of which about half is high grade, running 50 to 58 per cent iron, and the remainder low grade, containing 33 per cent iron. The Province of Hupei contains 38,676,100 tons of 55 to 65 per cent hematite. Nine other provinces in China contain known deposits of iron ore, and the total reserve of the country can be put at 943,709,700 tons of known ore and 355,242,000 tons of possible ore.

Japan.—Iron-ore reserves of Japan are not large, although several large mines are being worked. The Kamaishi mine, in the Province of Rikuchu, contains about 35,000,000 tons of magnetite ore averaging 60 per cent iron. There is about 6,000,000 tons of magnetite ore outside of the Kamaishi district. Red hematite ores are found in the Iwate, Kochi, and Kumamoto prefectures, which average 35 to 53 per cent iron. The reserve of these ores is put at 30,000,000 tons. There are also about 10,000,000 tons of brown ore, containing 53 to 62 per cent iron, scattered through Abuta, Kotaki, and Honshu. The Huang-Hai-Do district, in Korea, is said to contain about 4,000,000 tons of hematite ore carrying 50 to 60 per cent iron. Total reserves of Japan and Korea are put at 85,000,000 tons.

Siberia.—Although Siberia has never been thoroughly explored, it is known that it contains several large deposits of iron ore. In western Siberia, between Tomsk and Kuznetsk, there are several deposits of magnetite averaging 54 to 58 per cent iron, the total reserve of which is put at about 27,000,000 tons. It has been stated by some that the reserve of this district will run into billions of tons. Hematite and magnetite ranging from 35 to 65 per cent in iron occur in eastern Siberia in the Amur and Maritime provinces. The reserve of eastern Siberia is estimated at 6,000,000 tons.

Australia.—The iron-ore resources of Australia have already been described by me in an article in the Dec. 12, 1925, issue of *Engineering and Mining Journal-Press.* They are summarized as follows:

Australia is divided into seven states, including Tasmania, and, with the exception of the Northern Territory, all the states contain known deposits of iron ore. By far the largest iron-ore deposits in Western Australia are those of Koolan and Cockatoo islands. These contain about 547,300,000 tons of hematite ore averaging 52 to 69 per cent in iron. The remainder of the deposits in this state contain about 59,000,000 tons of hematite ore ranging from 42 to 60 per cent in iron. The Iron Knob and Iron Monarch deposits, in Man-

chester County, South Australia, are said to contain 133,200,580 tons of hematite ore running 53 to 68 per cent iron. There are many other deposits of iron ore in South Australia, but, aside from the Iron Prince and Iron Baron deposits, situated near the Iron Knob and Iron Monarch, which are said to contain 32,151,000 tons of similar ore, most of them are small. The total reserve of South Australia is estimated at 168,261,000 tons. Deposits of hematite are scattered through Queensland, but except for the Mount Philip deposit they are all small. The Mount Philip orebody contains 40,000,000 tons of hematite ore ranging from 52 to 57 per cent iron. The total reserve of Queensland is put at 46,435,000 tons. New South Wales also contains numerous small deposits of various grades of ore, the total reserve of which is about 53,725,000 tons. The Cadia deposit, the largest in New South Wales, contains 39,000,000 tons of hematite and magnetite averaging from 52 to 62 per cent in iron. Iron-ore deposits of Victoria are not so numerous, and the total reserve is put at only 1,900,000 tons of 48 to 66-per cent limonite ore. Tasmania contains several deposits of hematite and magnetite, the largest of which are at Long Plain and Blythe River. The Long Plain deposit contains 20,500,000 tons of magnetite ore carrying from 63 to 69 per cent of iron, and the Blythe River deposit contains 17,000,000 tons of hematite ore of about the same grade. The total reserve of Tasmania is estimated at 43,210,000 tons. That of Australia, including Tasmania, is 919,931,000 tons of actual ore and 42,498,000 tons of possible ore.

New Zealand.—The largest iron-ore deposits in New Zealand are at Parapara, on the northern end of South Island. These deposits contain about 64,000,000 tons of limonite ore varying from 43 to 59 per cent in iron content. Some deposits of titaniferous sand are found on the west coast of the North Island. These are said to contain about 5,374,000 tons of ore carrying 20 to 50 per cent iron. Total reserves of New Zealand ore are placed at 69,574,000 tons.

Philippine Islands.—There is an enormous deposit of lateritic iron ore very similar to the Mayari deposits of Cuba on the west coast of the Island of Mindanao, in Surigao Province. This ore averages 47.40 per cent in iron content, and the reserve is estimated at 800,000,000 tons. A small deposit of hematite occurs at Balacan, just north of Manila, which is said to contain about 1,200,000 tons, and another at Camaching, on the southern end of Luzon Island, which is estimated to contain about 4,000,000 tons of 60 per cent ore. The total reserve of the Philippines can be taken at 805,500,000 tons.

Dutch East Indies.—The largest deposits of iron ore in Borneo are on the Island of Seboekoe and at Soengei Doewa. The ore is laterite similar to the Surigao deposits and averages about 50 per cent iron. These deposits are said to contain about 400,000,000 tons. The Island of Celebes contains a large deposit of lateritic limonite ore at Larona which is estimated to contain 380,000,000 tons of ore averaging 49 per cent iron. A small deposit of magnetite ore is found at Pamatang Boerhan, on Sumatra Island, which contains 2,000,000 tons of 64 to 70 per cent ore and another deposit occurs in the Lampong district, which is said to contain 10,000,000 tons.

British North Borneo.—A deposit of limonite ore containing 25,000,000 tons and carrying about 56 per cent of iron occurs at Tagoho Hill, in British North Borneo.

Iron-Ore Reserves of the World

North America

United States

District and Deposit	Principal[1] Kind of Ore	Reserve (Thousands of Tons) Actual	Reserve (Thousands of Tons) Possible	Approximate Analysis Iron	Approximate Analysis Silica	Approximate Analysis
Superior—						
Mesabi	H.	1,652,786	39,000,000	58.00	8.00	.....
Vermilion	H.	30,000	1,000,000	62.00	6.90	.....
Cuyuna	H.	155,846	300,000	56.00	9.00	.....
Gogebic	H.	314,563	4,000,000	60.50	7.40	.....
Marquette	H.	185,633	16,000,000	58.00	10.20	.....
Menominee	H.	230,000	7,360,000	54.00	8.70	.....
Wisconsin	H.	77,500	4,500,000	49.00	8.50	.....
Total Superior District	.....	2,647,225	72,160,000	58.00	8.15	P.–1.00
Northeastern—						
Adirondacks	M.	2,000,000	.....	30–60	6–10	.....
N. Y. Clinton	H.	600,000	.....	35–45	.....	.....
Hudson Highlands	M.	35,000	.....	56.00	8.00	P.–.900
N. New Jersey	M.	135,000	.....	30–55	.....	.....
Pennsylvania	M.	82,000	.....	40.00	.....	.....
Pennsylvania	Car.	46,000	.....	30–35	.....	.....
Pennsylvania	Br.	10,000	.....	30–50	.....	.....
Ohio	Car.	200,000	.....	45.00	20.00	S.–.75
Indiana	Car.	25,000	.....	45.00	.....	.....
Total Northeastern States	.....	3,133,000	.....	.....	.....	.....
Southern—						
Birmingham	Cl., Br.	1,700,000	10,000,000	35–50	10–18	CaO.–16.00
Chattanooga	Cl., Br.	750,000	.....	30–40	10–20	.....
N. Carolina	M., Br.	15,000	.....	30–40	.....	.....
Vir., and Tenn.	Cl.	750,000	400,000	25–45	4–15	.....
W. Va., Ky.	Cl., Br.	5,000	102,000	30–40	.....	.....
Missouri	H.	75,000	50,000	48.00	7–25	.....
Texas	Br.	750,000	250,000	46.60	14.50	Al_2O_3–8.10
Total Southern States	.....	4,045,000	10,712,000	.....	.....	.....
Western—						
Wyoming	H.	20,000	.....	55.00	3–9	P.–.040
New Mexico	H.	15,000	.....	.....	.....	.....
Utah	M., H.	80,000	1,000,000	45–69	2–28	.....
California	H.	197,000	.....	62–67	2–6	.....
Montana	H.	300,000	.....	64.75	4.85	.....
Nevada	M., H.	7,000	.....	63.00	.....	.....
Colorado	M.	3,000	.....	.....	.....	.....
Alaska	M.	5,000	.....	.....	.....	.....
Total Western States	.....	627,000	1,000,000	.....	.....	.....
Total United States	.....	10,452,225	83,872,000	.....	.....	.....

Newfoundland

Bell Island—						
Wabana	H.	4,000,000	4,000,000	48–57	6–12	P.–.750

Canada

N. Brunswick—						
Bathurst	H., M.	18,000	.....	46.60	24.70	P.–1.00
Quebec—						
St. Charles	T.	5,000	.....	50.50	.....	TiO_2–10.50
Forsythe Mine	M.	500	.....	57.30	10.70	Concen.
St. Lawrence	T.	500	.....	.....	.....	.....
Ontario—						
Michipicoten	M.	2,000	.....	58.20	4.40	.....
Moose Mt.	M.	100,000	.....	36.70	45.20	.....
Atikokan	M.	25,000	.....	55.00	8.50	S.–2–12
Br. Columbia—						
Omineca	Bog.	7,500	.....	50–55	.....	.....
Kamloops	M.	8,000	.....	63.20	4.00	.....
Taseko	H., L.	72,200	.....	44.60	4–9	.....
Texada Is.	M.	5,000	.....	55–70	.....	.....
Total Canada	.....	243,700	20,000,000	.....	.....	.....

Mexico

Durango—						
Cerro del Mercado	H.	200,000	.....	60–65	3–7	.....
Michoacan—						
Las Truchas	H.	50,000	.....	63.90	6.00	.....
Colima—						
El Mamey	H.	40,000	.....	64–69	1–8	.....
Total Mexico	.....	290,000	.....	.....	.....	.....
Total North America	.....	14,985,925	107,872,000	.....	.....	.....

Central America and West Indies

Nicaragua

Pis Pis	M.	25,000	.....	65.00	.....	.....

Panama

Chorca Mts.	M.	25,000	75,000	60–65	.....	.....

Cuba

Oriente—						
Mayari	Br., H.	600,000	.....	46.00	5.50	Moist.–31.50
Levisa	Br., H.	75,000	.....	45.00	.....	.....
Oriente—						
Moa	Br., H.	1,985,000	.....	35–45	.....	.....
Daiquiri	M.	9,000	.....	55–65	.....	.....
Camaguey—						
San Felipe	Br., H.	450,000	.....	44.00	6.75	.....
Pinar del Rio	Br., H	40,000	.....	40.00	.....	.....
Total Cuba	.....	3,159,000	12,000,000	.....	.....	.....

Hayti

Dominican Republic	.....	41,000	.....	.....	.....	.....

Porto Rico

Mayaguez	L.	430,000	.....	40.50	2.50	AL_2O_3–20.00
Total Cent. America and West Indies	.....	3,680,000	12,075,000	.....	.....	.....

[1] H., hematite; M., magnetite; Car., carbonate; Br., brown; Cl., Clinton; Ti., titaniferous; Bog., bog ore; Mn., manganiferous; Ju., Jurassic; Sid., siderite; Cre., Cretaceous; S., sulphide; Oo., oolitic; Sp., spathic; Min., minette; Sil., siliceous; Pis., pisolitic; Lat., aterite; Goe., goethite.

District and Deposit	Principal Kind of Ore	Reserve (Thousands of Tons) Actual	Reserve (Thousands of Tons) Possible	Approximate Analysis Iron	Approximate Analysis Silica
South America					
Brazil					
Minas Geraes	Hl.	3,500,000	.....	63–70	.5–2.0
Matto Grosso, Bahia, etc.	H.	3,500,000	.....	60–70	.....
Total Brazil		7,000,000	.....	.....	.....
Chile					
Coquimbo— Tofo	H.	200,000	.....	67.50	2.50
Atacama— Algarrba	H., M.	200,000	.....	68.00	.....
Chanaral	H., M.	500	.....	60.10	5.00
Valdivia	H., M.	40,000	.....	.....	.....
Total Chile		440,500	.....	.....	.....
Dutch Guiana					
Donderbary	Br.	100,000	.....	43.60	2–10
Peru					
Ica— Marcona	H.	500,000	.....	60–65	3.50
Huancayo— Huacravila	H.	64,000	.....	67–70	2–13
Total Peru		564,000	.....	.....	.....
Uruguay					
Rivera— Zapucay	Mn.	80,000	.....	35.00	9.00
Venezuela					
Imataca— Orinoca	H., M.	10,000	.....	66.50	2.00
Piacoa— Colon	H.	5,000	.....	59.40	7 30
Total Venezuela		15,000	.....	.....	.....
Total South America		8,200,000	.....	.....	.....
Europe					
Great Britain					
Northampton	Ju.	1,655,000	.....	38.20	17.40
Lincolnshire	Ju.	997,500	.....	25–30	9–13
Yorkshire	Sid.	380,000	400,000	30.20	12.80
Dorset, Kent, Oxford, etc.	Ju.	374,000	320,000	34.00	42.00
Derby and Nottingham	Car.	597,900	.....	23–33	3.5–17.2
Stafford, Worcester, etc.	Car.	1,435,400	.....	30–35	3.00
Yorkshire	Car.	197,800	.....	30–35	.....
Scotland	Car.	84,300	423,200	30–35	.....
Wales	Car.	.....	5,000,000	30–35	.....
Cumberland and Lancashire	H.	130,000	55,000	50–53	11–15
Durham	Br.	250	.....	38–43	9.00
Somerset, Bristol, etc.	H.	250	.....	35–45	.....
South Devon and Cornwall	H., M.	500	500	35–45	.....
Gloucester	Br.	1,000	.....	35–45	.....
S. Wales— Llanharry	H.	8,000	.....	55.00	6.00
Wiltshire	Cre.	5,500	.....	26.60	17.50
Sussex and Kent	Cre.	100,000	.....	23.00	.....
Ireland— Ballycastle	Car.	2,200	.....	30.20	.....
Total Great Britain		5,969,600	6,198,700	.....	.....
Norway					
Sydvaranger	M.	115,000	.....	35–37	43–45
Dunderland	M.	150,000	890,000	39.00	10–60
Narvik	M	10,000	.....	20.00	.....
Generalhougen, etc.	M.	15,000	1,255,000	16.00	.....
Sorreisen, etc.	M.	15,000	.....	33–35	.....
Solligangen, etc.	M.	20,000	.....	25.00	.....
Soggendal, etc.	Ti.	500	.....	40.00	.....
Rodsand	Ti.	500	.....	46.50	10.00
Solnordal, etc.	Ti.	5,000	20,000	50.00	.....
Loften Island	Ti.	15,000	.....	33.00	.....
Island of Hindo	M.	1,500	.....	27.88	.....
Flakefjord	M.	2,000	55,000	45.00	19.00
Beltstadfjord	M.	7,500	.....	55.00	.....
Klodeberg	M.	500	.....	42.50	25.00
Lango, Gomo, etc.	M.	1,000	.....	40–45	30.00
Sulitjelma	S.	17,000	10,000	62.00	.....
Christiania	H., M.	8,000	7,000	50.00	.....
Total Norway		383,500	1,347,000	.....	.....
Sweden					
Kiirunavaara	M.	1,500,000	.....	58–69	1–2
Luossavaara	M.	100,000	.....	60–70	.....
Gellivaraara	S.	225,000	.....	59–69	.....
Koskulla-Kulle	H., M.	40,000	.....	59–69	.....
Leveaniemi	M.	38,000	500,000	43–66	.....
Mertainen and Painirova	M.	48,000	.....	43–66	.....
Towliuvaara	M.	6,850	.....	50–65	.....
Ekstromsberg	M.	48,500	.....	60.00	.....
Ruovtevare	M.	12,000	.....	40–50	.....
Grangesberg	M.	100,000	124,000	60.00	.....
Nordberg and Strassa	M.	85,000	.....	50–60	.....
Taberg	Ti.	.....	50,000	20–30	.....
Total Sweden		2,203,350	674,000	.....	.....
Finland					
Jussaro	H.	30,000	.....	40.00	.....
Pitkaranta	M.	13,000	7,000	38.00	.....
Total Finland		43,000	7,000	.....	.....
Russia					
Southern— Krivoi Rog	H.	400,000	.....	50–70	1–6
Lichmand'skaja	H, M.	6,000	.....	50–70	.....
Kertch	Oo.	500,000	.....	35–42	12–15
Central— Lipetsk	Br. H.	700,000	400,000	52.00	.....
Valdimir	Br. H.	100,000	75,000	40.00	.....
Orel	Sp.	9,000	37,000	41.00	.....
Ural Mts.— Bogoslovski	H., M.	3,000	1,000	40–60	.....
Kolonija, etc.	H., M.	1,150	.....	50.00	.....
Kutimskoje	H., M.	580	.....	50–63	.....
Voronzov	H., M.	790	.....	50–63	.....
Kiselovski	Br. H.	3,000	.....	45.00	.....
Perm and Viatka	Sid.	60,000	.....	22.00	.....
Gora Blagodat	M.	17,000	.....	55–59	.....
Nijni Tagilsk	M.	13,000	.....	63–69	.....
Verak Isetsk	Br. H.	9,000	9,000	50–60	.....
Alapaievsk	Br. H.	100,000	50,000	46–50	.....
Bilimbaievski	H.	1,000	.....	51–57	.....
Sissert	M., Br.	2,000	5,000	.....	.....
Ufalievski	M., Br.	6,000	.....	.....	.....
Magnitnaia Gora	M., H.	38,000	.....	58–62	1–23
Karabijskoje	Br.	10,000	.....	49–56	.....
Lemesinski	Br.	1,000	.....	54.50	.....
Bakalsk	Br.	52,000	10,000	50.00	.....
Kussinskaia	Ti.	4,000	.....	53–63	.....
Achtenskoje	Br.	330	.....	43–51	.....
Caucasus— Daschkicssan	Br.	20,000	30,000	62.00	.....
Total Russia		2,056,850	617,000	.....	.....
Germany					
East Rhine— Siegerland	Sid.	166,000	50,000	38–40	.....
Dill and Lahn	H.	258,250	100,000	42–48	12–25
Vogelsberg, etc.	Br.	17,000	15,000	20–25	.....
Spessart	Car.	3,500	3,500	33.00	.....
Bergischer-Kalkberg	Br.	9,000	4,000	40.00	.....
Weser— Salzgittern-Iisede	Br.	278,000	1,000,000	30.00	.....
Harz Mts.	H.	42,600	55,000	30–49	3–18
Kellerwald	H.	12,000	.....	28.00	.....
Bentheim	Car.	15,000	200,000	35.00	.....
Teutoburger	Car.	44,000	100,000	18.00	.....
Mardorf-Zwosten	Br.	2,500	2,000	30.00	.....
Others	Oo.	45,000	100,000	33.00	.....
Bavaria, Württemberg	Br.	292,000	1,100,000	50–55	.....
Thuringia	Ch.	104,000	105,000	30.00	.....
North, Central Germany	Bog.	16,000	8,000	30.00	.....
West Rhine	Br.	9,300	500	20–40	.....
Schmiedeberg	M.	2,600	.....	50.00	.....
Total Germany		1,317,050	2,843,000	.....	.....
Luxemburg					
Lorraine Basin	Br.	270,000	.....	26–40	4–15
Belgium					
Campine	Br.	15,000	.....	30–35	.....
Namur-Liege	H.	50,000	66,000	25–45	6–27
Cent. & S. Belgium	L.	4,500	.....	.....	.....
Lorraine Basin	Br.	500	.....	34–41	.....
Total Belgium		70,000	66,000	.....	.....
France					
Lorraine— Nancy	Min.	250,000	1,000,000	32.00	.....
Briey	Min.	2,500,000		36–40	.....
Crusnes	Min.	650,000		25–45	.....
Longwy	Min.	350,000		25–40	.....
Annex	Min.	2,300,000	500,000	26–40	8.00
Normandy— Dielette	M.	100,000	50,000	52–55	6–10
Orme, Calvados, etc.	M.	1,175,000	2,000,000	43–55	7–14
Brittany, Anjou	Br., Sid.	750,000	500,000	50.00	16.00
Pyrenees-Oriental	H., Car.	60,000	30,000	53–57	.....
Haute-Marne	Oo.	13,500	10,000	43.00	14.00
Basses Pyrenees	H., Car.	600	.....	51–55	.....
Bordeaux Basin-Lot	Br.	250	.....	.....	.....
S. Central France	Br.	12,000	.....	.....	.....
S. Eastern France	Br.	3,000	.....	50.00	.....
Total France		8,164,350	4,090,000	.....	.....
Spain					
Cantabrian-Cordillera-Lugo	H., M. Sp.	120,000	40,000	37–52	12–16
Leon	Sid., Car.	166,000	.....	32–52	6–46
Oviedo	Sil.	110,000	50,000	48–52	16–20
Santander	Br.	20,000	.....	47.00	9.40
Vizcaya	Sp.	35,000	30,000	50.00	3–12
Pyrenees— Guipuzcoa, etc.	Br.	12,000	4,000	57–68	3.50
West of Ebra R.— Saragossa	H.	34,000	.....	60.00	.....
Logrono	H.	.....	20,000	37–58	7–16
Sierra Menera	H., Sp.	130,000	60,000	52–60	3–10
Sierra Fregenal	H., M.	7,000	7,000	55–66	3.00
Sierra Morena— Huelva	M., Br.	324,000	.....	51–58	12–20
Seville	M., Br.	36,000	18,000	52.00	15.00
South Coast— Malaga	M.	10,000	.....	61.20	8.70
Granada	M., H.	17,000	10,000	40.00	4.50
Almeria	H., Sp.	69,000	24,000	50–57	.....
Murcia	Br.	25,500	10,000	43–56	4–12
Total Spain		1,115,500	273,000	.....	.....
Portugal					
Moncorvo— Tras os Montes	H., M.	20,000	25,000	34–55	2–45
Porto de Moz.— Mendiga Arrimal	Oo	3,000	.....	50–55	.....
Soa Thiago de Cacem	H.	10,000	.....	20–50	2–35
Serra dos Monges	M., Br.	17,000	.....	48–58	4–19
Total Portugal		50,000	25,000	.....	.....

1 H., hematite; M., magnetite; Car., carbonate; Br., brown; Cl., Clinton; Ti., titaniferous; Bog., bog ore; Mn., manganiferous; Ju., Jurassic; Sid. siderite; Cre., Cretaceous; S., sulphide; Oo., oolitic; Sp., spathic; Mn., minette; Sil., siliceous; Pis., pisolitic; Lat., laterite; Goe., goethite.

Switzerland

District and Deposit	Principal Kind of Ore	Reserve (Thousands of Tons) Actual	Reserve (Thousands of Tons) Possible	Approximate Analysis Iron	Approximate Analysis Silica	Approximate Analysis
Fricktal	L.[1]	15,000	22,000	25–35	13–20	CO_2 8–12
Jura Mts.	Pis.	1,000	1,000	42.00	.....	.....
Chamoson, Erzegg—Planplatten	Jur.	2,500	2,500	30.00	.....	.....
Mt. Chemin, Avers and Gonzon	M.	.....	1,000	54–57	.....	.....
Total Switzerland		18,500	26,500	.....	.....	.....

Italy

Elba	M., H.	2,500	.....	40–62	.....	.....
Piedmont—Val d'Aosta	M.	6,000	.....	66.00	.....	.....
Sardinia—La Nurra, etc.	L., Car.	7,000	.....	53–56	.....	.....
Central Italy—Val d' Aspra	Br.	1,500	.....	49.00	9.00	.....
Orbetello	Mn.	1,300	.....	45.00	.....	Fe + Mn.
Total Italy	.....	18,300	.....	.....	.....	.....

Greece

Lokris, Thebes, Kapais	H.	80,000	50,000	46–52	5–11	Al_2O_3–6–14

Jugo-Slavia

Bosnia—Vares	H., L.	41,000	40,000	38–50	6–11	Mn.–.1–11
Ljubia	L.	3,500	.....	60.00	.....	.....
Serbia—Majdanpek	L.	2,000	.....	.....	.....	.....
Total Jugo-Slavia		46,500	40,000	.....	.....	.....

Rumania

Banat—Bihar, etc.	H. M.	8,000	8,000	50–65	.....	.....
Hunyad	L.	17,000	.....	34–45	18.00	Mn.–1.5–3.5
Total Rumania		25,000	8,000	.....	.....	.....

Poland

Czenstochau	Sp.	182,500	210,000	26–30	.....	.....
Warsaw, Kalisch	Bog.	4,000	2,000	30–35	.....	.....
Total Poland		186,500	212,000	.....	.....	.....

Bulgaria

B'agovest—Spassenije	M., H.	1,450	.....	52–64	.....	.....

Austria

Styria—Erzberg	Sid.	228,000	150,000	38.70	4.10	CO_2–27.50
Carinthia—Huttenberg	Sid., L.	14,000	.....	43–49	.....	.....
Total Austria		242,000	150,000	.....	.....	.....

Czechoslovakia

Bohemia—Brda Mts.	H.	257,000	183,000	32–36	12–14	.....
Ruthenia—Szepes–Gomor	Sid, Br.	73,800	18,000	35–50	8–22	.....
Moravia—March, Sudetic	H.	4,600	.....	44–66	4–25	.....
Carpathians—Zaros, etc.	H.	1,000	.....	43.80	.....	Mn. 1.10
Total Czechoslovakia		336,400	201,000	.....	.....	.....
Total Europe		22,598,350	16,818,200			

Africa

Algeria

Dept. of Oran, Algiers	H.	40,000	.....	46–54	3.50–19	.....
Dept. of Constantine	H. M.	60,000	.....	48–60	1–4	.....
Total Algeria		100,000	.....	.....	.....	.....

Tunisia

Nefzas—Douvaria	H.	8,000	.....	52.30	7.00	.....
Djerissa—Slata	H.	20,500	.....	48–55	1–3	Mn. 2–3
Gafsa	H.	60,000	.....	52.00	6.00	P.–1.25
Total Tunisia		88,500	.....	.....	.....	.....

Morocco

Melilla—Spanish	H.	30,000	.....	62.00	6.00	.....

French West Africa

Togoland—Banyeli		20,000	.....	50.00	9.50	.....

British West Africa

Sierra Leone—Devil Hole	Lat.	3,000	.....	59.90	.....	.....
Nigeria	L., Br.	.....	2,000,000	50.00	.....	.....
Total British West Africa		3,000	2,000,000	.....	.....	.....

British East Africa

Nyasaland—Dzonze	H.	53	.....	69.00	.....	.....

[1] H., hematite; M., magnetite; Car., carbonate; Br., brown; Cl., Clinton; Ti., titaniferous; Bog., bog ore; Mn., manganiferous; Ju., Jurassic; Sid., siderite; Cre., Cretaceous; S., sulphide; Oo., oolitic; Sp., spathic; Min., minette; Sil., siliceous; Pis., pisolitic; Lat., laterite; Goe., goethite.

Madagascar

District and Deposit	Principal Kind of Ore	Reserve (Thousands of Tons) Actual	Reserve (Thousands of Tons) Possible	Approximate Analysis Iron	Approximate Analysis Silica	Approximate Analysis
Ambatolaona	M.	4,000	.....	65.00	.....	.....
Betsiriry	Ti.	3,500	.....	.....	.....	.....
Total Madagascar		7,500	.....	.....	.....	.....

Union of South Africa

Transvaal—Magnet Heights	Ti.	24,000	2,000,000	60.20	3.00	TiO_2–14.3
Pretoria	Sil.	400,000	.....	44–54	14–35	.....
Potchefstroom	Sil.	600,000	.....	48.00	18.00	.....
Buffelshock	H.	50,000	.....	64–68	.....	.....
Kromdraai, etc.	H.	10,000	.....	55–65	5–19	.....
E. Transvaal	H.	10,000	.....	57–62	2–11	.....
Natal—Maritz	L.	1,135	.....	35–62	.....	.....
Total Union of S. Africa		1,095,135	2,000,000	.....	.....	.....

Rhodesia

Lake Bangweolo	L.	.....	6,000,000	25.00	.....	.....
Total Africa		1,344,188	10,000,000	.....	.....	.....

Asia

Transcaucasia

Dashkesan, Tchatakh, etc.	H., M.	13,000	.....	54.00	.....	.....

Persia

Bishneh	H.	500	.....	62.70	.....	.....
Durdur	H.	250	.....	65.60	.....	.....
Total Persia		750	.....	.....	.....	.....

India

Manharpur	H.	10,000	.....	64.00	2.10	.....
Mayurbhanj	H.	39,400	20,000,000	60.00	5.80	.....
Singhbhum	H.	3,000,000	.....	64–67	.....	.....
Burma—Singaung	H.	200	.....	56–60	3–14	.....
Jubbulpore—Agaria	H.	14,000	.....	50–60	7–14	.....
Saroli	H.	3,500	.....	64–68	.....	.....
Jubbulpore—Bijori	H.	49,000	.....	57.50	.....	.....
Drug—Dhali	H.	10,000	.....	68.50	.70	.....
Mysore—Kadur	H.	100,000	500,000	55–60	1–3	.....
Malvalli, etc.	H.	100,000		57.00	.....	.....
Total India		3,326,100	20,500,000	.....	.....	.....

China

Chihli—Luan Hsien	H., M	32,424	5,000	33.00	43.00	.....
Hsuan-Lung	Oo.	45,736	46,142	50–58	7–20	.....
Fengtein—Pen-Ch'i-Hsien	M.	74,275	.....	37–68	4–45	.....
Kung-Ch'ang-Ling	M., H.	270,020	300,000	30–40	45–57	.....
An Shan	M., H.	413,740	.....	60–65	.....	.....
Kuo-Ti-Shan	M., H.	1,950	.....	26–31	55.00	.....
Shantung—Chin-Ling-Chen	M., H.	13,700	.....	55–66	.....	.....
Honan—Wu An	H.	1,000	.....	60.00	10.00	.....
Hupei—Ta Yeh	H., M.	26,462	.....	65.00	5.00	.....
Ling-Hsiang	H., L.	6,342	.....	60.00	10.00	.....
O'Ch'eng	H.	12,334	.....	53–56	.....	.....
Anhui—Tu'ng-Kuan-Shan	H., M.	3,190	.....	55–62	.....	.....
Fan-Ch'ang-Hsien	H.	4,224	.....	61.00	.....	.....
Tang-Tu-Hsien	H., M.	9,175	.....	57–65	5–15	.....
Kaingsu—Li-Kuo-Yi	H.	3,070	.....	56.00	10.00	.....
Chiang-Ning-Hsien	H.	2,000	2,000	59.00	12.00	.....
Chekiang—Chang-Hsing	H., L.	200	.....	30–50	.....	.....
Fukien—An-Chi-Hsein	M.	12,000	.....	65.00	.....	.....
Kuangsi—Hong Kong	M.	5,000	.....	43–60	.....	.....
Kiangsi—Cheng-Men-Shan	H., L.	6,288	.....	30–60	.....	.....
Tui-Ch'ang-Hsien	H.	580	.....	56.10	8.35	.....
Yung-Hsien-Hsien	.....	.....	2,100	50.00	.....	.....
Total China		943,710	355,242	.....	.....	.....

Japan

Kamaishi—Rikuchu	M.	35,000	.....	60.25	6.40	.....
Kuriki—Mizusawa	M.	6,000	.....	.....	.....	.....
Iwate—Kochi, Kumamoto	H.	30,000	.....	35–53	9–43	.....
Abuta, Kotaki, Honshu	Br.	10,000	.....	53–62	1–8	.....
Korea—Huang-Hai-Do	H.	4,000	.....	50–60	.....	.....
Total Japan		85,000	.....	.....	.....	.....

Siberia

Western—Telbess	M.	6,670	.....	58.00	.....	.....
Temir-Tau	M.	8,527	.....	54.00	.....	.....
Altai, Kirghiz, Tyumen, etc.	M.	11,803	.....	.....	.....	.....
Eastern—Belaya Gora	M.	2,284	.....	40.00	.....	.....
Amor-Little Khingan	H.	2,708	.....	35–65	.....	.....
Ussuri-Serhievsk Bog.		903	.....	40–50	.....	.....
Total Siberia		32,895	.....	.....	.....	.....
Total Asia		4,401,455	20,847,242	.....	.....	.....

Pacific Islands

Australia

District and Deposit	Principal Kind of Ore	Reserve (Thousands of Tons) Actual	Reserve (Thousands of Tons) Possible	Approximate Analysis Iron	Approximate Analysis Silica	Approximate Analysis
Western—						
Koolan Islands	H.	426,550	.....	65–67	4–7	.....
Cockatoo Islands	H.	120,750	.....	51–69	1–26	.....
Wilgie Mia	H.	26,500	.....	64–69	1–2.50	.....
Gabanintha	H., M.	1,500	.....	52.15	.20	P.–.008
Mt. Gibson	H.	10,000	.....	68.00	.....	.....
Mt. Caudan	Goe.	20,000	20,000	43–62	2–23	.....
Koolyanbling	Goe.	1,000	1,000	60.00	5.00	.....
South—						
Iron Knob	H.	2,488	.....	64.00	2.00	.....
Iron Monarch	H.	130,712	.....	64.40	2.15	.....
Iron Prince, Baron	H.	32,151	.....	65.72	2.00	.....
Mt. Bessemer	H.	536	.....	45–60	.....	.....
Peerallila	L.	45	.....	49.00	.....	.....
Koolka	M.	414,000	.....	65.64	2.06	P.–.30
Donnelly's	L.	470,000	.....	49–58	.....	.....
Cutana	Br.	810,000	190	43–47	21–25	.....
Mingary	L.	250,000	.....	57.00	.....	.....
Billeroo	M., H.	385,000	.....	50.00	25.00	.....
Queensland—						
Mt. Leviathan	H.	2,000	.....	56–62	8–17	.....
Mt. Philip	H.	40,000	20,000	52–56	19–23	.....
Mt. Pisa	H.	1,000	1,000	55–62	.....	.....
Mt. Lucy	H., M.	350	.....	63.90	1.70	.....
Iron Island	H., M.	1,507	.....	64.70	2.50	.....
Olsen's Caves	H., M.	250	.....	66.00	2.85	.....
Oakey Lode	H., M.	118	.....	56.30	10.40	.....
Plesant Lode	H., M.	250	.....	55.40	12.80	.....
Pittsworth	L.	10	.....	50.00	.....	.....
Rolliston	L.	50	.....	52.00	.....	.....
Biggenden	H.	300	308	.....	.....	.....
Glassford	H., M.	500	.....	.....	.....	.....
Mt. Perry	Br.	100	.....	34–43	.....	.....
Peter's Nob	Br.	100	.....	34–43	.....	.....
New South Wales—						
Cadia	H., M.	39,000	.....	52–62	9–15	.....
Carcoar	H.	3,000	.....	55–58	5–8	.....
Wingello	Al.	3,260	.....	20–25	3–12	Al_2O_3–30–37
Gulgong	M.	120	.....	65.00	.....	.....
Cowra	M.	100	.....	66.00	.....	.....
Queanbeyan	M.	1,000	.....	65.00	.....	.....
Chalybeate	L.	1,510	.....	45–58	.....	.....
Bredalbane	L.	700	.....	59.50	.....	.....
Goulburn	L.	1,022	.....	45–55	.....	.....
Mandurma	L.	609	.....	52–58	.....	.....
Marvlan	H.	40	.....	46–50	.....	.....
Mudgee	L., M.	150	.....	54.50	.....	.....
Newbridge	Br.	150	.....	56.00	.....	.....
Rylstone	Br.	443	.....	46–56	.....	.....
Talbragar	L.	400	.....	46–50	.....	.....
Wallerawang	Br.	200	.....	49–56	.....	.....
Korvah	Ti.	2,021	.....	40–50	.....	.....
Victoria—						
Lal Lal	L.	750	.....	68.70	17.30	.....
Nowa Nowa	L.	400	.....	60–66	.....	.....
Mirboo	L.	500	.....	65–70	.....	.....
Little Whipstick	L.	250	.....	.....	.....	.....
Tasmania—						
Long Plain	M.	20,500	.....	63–69	.5–2.50	.....
Zechan	M.	3,710	.....	60–70	.5–2.0	.....
Blythe River	H.	17,000	.....	63–69	1–8	.....
Beaconsfield	Br.	1,300	.....	53–57	3–8	.....
Dial Range	H.	700	.....	60–70	.....	.....
Total Australia		919,931	42,498	.....	.....	.....

New Zealand

Parapara—						
S. Island	L.	64,000	.....	45–59	4–20	.....
West Coast—						
N. Island	Ti.	5,374	.....	20–50	.....	TiO_2–2–10
Cape Kerr	L.	100	.....	48.35	.....	.....
Waitangi Stream	L.	100	.....	45–50	.....	.....
Total New Zealand		69,574	.....	.....	.....	.....

Philippine Islands

Luzon—						
Balacon	H.	1,500	.....	55–65	1–10	.....
Comaching	H.	4,000	.....	60.00	.....	.....
Mindanao—						
Surigao	Lat.	800,000	.....	47.40	.....	Al_2O_3–10–12
Total Philippines		805,500	.....	.....	.....	.....

East Indies

Borneo—						
Seboekoe	Lat.	300,000	.....	50.00	.....	.....
Soengei Doewa	Lat.	100,000	.....	50–54	2.50	.....
Celebes—						
Larona	Lat.	380,000	.....	49.00	.....	.....
Sumatra—						
Pamatany Boerhan	M.	2,000	.....	64–70	2–9	.....
Lampong	M.	10,000	.....	60–70	.....	.....
North Borneo—						
Tagoho Hill	L.	25,000	.....	56.00	.....	.....
Total East Indies		817,000	.....	.....	.....	.....
Total Pacific Islands		2,602,005	42,498	.....	.....	.....
TOTAL— WORLD'S RESERVE		57,811,923	167,662,940	.....	.....	.....

1 H., hematite; M., magnetite; Car., carbonate; Br., brown; Cl., Clinton; Ti., titaniferous Boz., bog ore; Mn., manganiferous; Ju., Jurassic; Sid., siderite; Cre., Cretaceous; S., sulphide; Oo., oolitic; Sp., spathic; Min., minette; Sil., siliceous; Pis., pisolitic; Lat., laterite; Goe., goethite.

More Phosphate Rock Produced in 1925

The total quantity of phosphate rock mined in the United States and sold in 1925 was 3,481,819 long tons, valued at $11,545,678, according to a statement of the U. S. Bureau of Mines. The figures given are based on reports furnished by producers. They indicate an increase of 21 per cent in quantity and of 13 per cent in value, as compared with 1924. Imports of phosphate rock in 1925 were 2,735 long tons, valued at $37,932, a quantity decrease of 83 per cent and 79 per cent in value.

Spanish Zinc Production in 1924

Owing to the phenomenal rise in lead and zinc prices during 1925 and the last half of 1924, there has been greatly increased interest in the Spanish zinc deposits, the U. S. Department of Commerce states. Although there are no reliable figures indicating the resources of this mineral in Spain, a considerable amount of prospecting has been carried on in the northern provinces of Asturias and Santander. Large deposits of zinc ore have been discovered on both slopes of the Cantabrian range, but on account of transportation difficulties the only mining operations actually undertaken have been on the extreme northern side of the mountains and as close to tidewater as possible. A number of engineers report considerable zinc deposits on the higher slopes of this mountain range, but because of winter snows and their comparative inaccessibility many of these ore finds still remain unclaimed. The decrease in the world's present visible zinc supply may lead to a still further interest in these new-found Spanish deposits.

Several well-known German refiners are much interested in the new Spanish zinc discoveries. Although these firms have not taken up any claims, they have been active in securing such ores as are available through their representatives, who remain in close touch with the situation. An authority on Spanish mining matters has informed the Department of Commerce that if it were not for the present financial stringency in Germany these refiners would undoubtedly go into mining.

The Spanish Ministry of the Interior has just published the annual mining statistics for 1924. This publication contains a number of figures which in every way substantiate the reported increasing interest in the Spanish zinc deposits. From these data and a number of other official and semi-official statements, the following information on the Spanish zinc situation has been gathered together in the best form possible:

On Dec. 31, 1924, thirty-seven productive zinc mines were being operated in Spain the total number of hectares taken up on these mines was 611. On that same date there were 522 unproductive mines covering 8,108 hectares, thus bringing the total zinc concessions up to 559 and 8,023 hectares. In 1924, 11 new concessions for zinc mines were granted and 35 expired.

A Timbering Job

BY D. E. A. CHARLTON

Cap'n Dick was watching the timber gang getting ready to put a set in place. "All of these 'ere boys," said he, "be mighty 'andy, an w'en they get through with a set thee may depen' on h'it that tha job's a snug an fitty one. For tha cuttin' an' tha wedgin' h'all be done proper-like an' with a h'eye to beauty, as near can be. But tha job that's got to be done be tha main thing. Speakin' o' sawin' an' such, an' tha h'idea o' 'avin' things so that they do the job they be supposed to do, remin's me o' tha story o' Jan Penglase an' 'is dog. Ee 'ad a bit o' one o' these 'ere terriers that ee wuz mighty praud o', for ee 'ad got 'im from a farmer chap 'oo wuz takin' 'im 'long for to drown 'ee. 'W'ot's for goin' to do that?' sez Jan. 'Oh, 'ee be h'always chewin' tha paint h'oft tha legs o' tha sofa,' sez tha farmer. 'Well,' sez Jan, 'h'if that be h'all, thee better give 'im to me for I can cure 'im o that.' An 'ee did too, for, dam-me, Jan sawed tha legs h'off tha sofa."

Present Trend in Metallurgical Practice in Northern Ontario

By Henry Hanson

Henry Hanson

THE OUTSTANDING recent improvements in northern Ontario metallurgical practice may be summarized as follows:

1. Primary crushing underground.
2. Finer grinding of sulphides.
3. Filter installation to reduce dissolved gold losses.
4. Double filtration and pachuca agitation.

1. Primary and secondary crushing, intermediate and fine grinding has been pretty much standardized, and broadly speaking consists of large primary jaw crushers underground, secondary gyratory crushers on surface, followed by one-step roll reduction, the product from the rolls going to ball mills or rod mills, and from either of these intermediate grinders to tube mills for regrinding. This practice is well established and applies to all the larger mines at Kirkland Lake and Porcupine, with the exception of coarse crushing underground, which has not yet been adopted by all. The underground crushers reduce the ore to about 6- to 8-in. size, the handling from then on being much facilitated by the absence of large chunks.

2. As the sulphides contain more gold than the gangue material, and are also more rebellious in releasing it, the problem has been to separate this product from the gangue, and subject it to finer grinding; and although the same objective has been aimed at by all, it has been attained differently. At one of the large Porcupine plants the sulphides are ground finer and kept in circulation longer by maintaining a double closed circuit, consisting of cones. At a second plant the same thing is aimed at by two-stage tube mill regrinding in closed circuits, employing bowl classifiers in the final stage; and at a third plant the sulphides are removed on concentrating tables, and then subjected to regrinding and separate treatment. The principle involved in the closed-circuit method is that, given settling facilities, the sulphides, being of a higher specific gravity, will settle out more readily than the gangue, and will be returned to the regrinder in the closed circuit. Under proper control, little of the sulphides will overflow the classifier until they are at least fine enough to pass a 200-mesh screen.

Comparative microscopic examination of the sulphides reground in separate circuits after table concentration, with sulphides reground in double closed circuit, would be of interest, as well as comparative assay results on the sulphides in the final tailing. In the absence of complete data on these various phases of the problem, an opinion as to the relative merit of the different methods in the operations considered would be without value.

The Kirkland Lake ore is harder than that of Porcupine and offers more difficulty in obtaining high recoveries. The practice there is somewhat finer grinding of the whole product than at Porcupine. No serious attempt has been made at table concentration, but bowl classifiers have recently been introduced at one of the plants to work in closed circuit with tube mills, no doubt with the object of settling out and finer grinding of the more refractory part of the ore.

3. It is my opinion that counter-current decantation has been too much emphasized, and that mill operators have come to a tardy realization of the fact that greater losses in dissolved gold are entailed in the counter-current system, when used without filters, than the theoretical formula or even the company records would indicate. Filters now find a place in all the Porcupine plants, and at least in the "big three" at Kirkland Lake —Teck-Hughes, Lake Shore, and Wright-Hargreaves. New plants are making filters a part of the equipment, and it is now generally conceded that filter installation is not only up-to-date practice, but is sound economy as well.

4. In a recent addition to one of the large plants in Porcupine, double filtration equipment was installed, thus eliminating counter-current thickeners. In the same plant, pachucas were given preference over the mechanical agitators. This is the first attempt in northern Ontario to get away from the counter-current system entirely. It is claimed that pachucas can be operated more economically than mechanical agitators, and that they are easier to start after a shutdown. Another advantage that seems to favor the pachucas is that in large installations there appears to be a saving in the space required. This, however, would apply much more when comparing the space required by double filtration to that required by counter-current tanks, and, no doubt, played an important part in causing the respective companies to reach a decision to install double filtration and pachuca agitators.

Haulage at the Homestake Mine

Previous to 1901 underground haulage at the Homestake mine was accomplished by means of mules and horses and surface haulage by three 5-ton steam locomotives, according to S. J. Staple and Hugh A. Mackie, in the May issue of the *Black Hills Engineer*. This work has since been done by compressed-air locomotives, of which there are thirty-three, with charging stations in suitable locations. There are ten 3½-ton and twenty 5-ton locomotives for underground service; and two 7½-ton and one 14-ton engine for the surface tramway. The 14-ton air locomotive which replaced the steam locomotive on the surface tramway hauls a train of thirty-two cars of 4-ton capacity, or a total of 128 tons per trip. The train hauled by the underground locomotives varies with the grade and track conditions, the maximum being forty-five cars of 1-ton capacity.

A safety feature has recently been applied to each locomotive to prevent it from being moved before breaking connection at a charging station. This is avoided by a relief valve placed in the intake line between valve chests, with a rod extending along the frame to the operator. On the end of this rod is a lever which is set close to the charging stub. Before the charging coupling can be attached, interference of this lever makes it necessary to open the relief valve. Should the throttle be open while charging is in progress, air under pressure could not enter the cylinder but would escape through the relief valve.

Advantages of Cubes Over Balls as Grinding Media

Plane Instead of Spherical Surfaces Greatly Increase Area of Effective Contact—No Tendency to Wear Except at Corners —Superiority to Rods Also Indicated

By E. H. Rose

Mill Superintendent, Patiño Mines & Enterprises Consolidated, Inc., Llallagua, Bolivia

E. H. Rose

DURING the last few years a considerable interest has been evoked on the subject of cubical shapes for grinding media for use in ball or tube mills. The point that immediately arrests attention is the fact that cubes do actually retain their original shape throughout their life in the mill. A search for the explanation of this retention of shape reveals many interesting theoretical considerations, not superficially apparent, which point to the cube as a most logical, if not the most logical, shape to be used in a revolving mill. It is the purpose of the present paper to present and analyze those considerations.

I was until a short time ago associated at the Nacozari concentrator of the Phelps Dodge Corporation in Mexico with William T. MacDonald, who probably was the originator of cubical grinding media. All of the experimental work with cubes thus far done by him and others in the United States and Mexico has been upon sulphide ores, subsequently treated either wholly or in part by flotation. One of the chief virtues of cubes, as will be hereinafter shown, is their avoidance of sliming. Sliming, in flotation work, is detrimental if carried to excess, but is not necessarily ruinous; in the concentration of cassiterite—which is the problem upon which I happen now to be engaged—sliming of the mineral is suicidal, for cassiterite, not being amenable to flotation, must be concentrated by gravity processes which do their poorest work upon slime. At present market prices, a tailing containing 0.60 per cent tin—about the best that may be expected from gravity concentration—is equivalent in value to a tailing from a copper concentrator of about 2.65 per cent copper. With slime tailings averaging considerably higher in grade than the coarser rejects, it is easily understandable why certain tin concentrators are looking with interest upon cubical grinding media as a partial cure for, or rather partial elimination of, their slime problem, and the experience which it is now hoped to gain should be of general interest throughout the profession.

The following discussion of the theory of grinding cubes was written at Nacozari nearly two years ago, but has not hitherto been available for publication.

Fundamentals of Grinding

In tube mills employing manufactured grinding media, practically all crushing or grinding which occurs takes place between metallic bodies, either by impact, by pressure, or by a combination of both. The ore particles crushed may be caught between the mill lining and the grinding medium, or between adjacent balls, cubes, or rods, as the case may be, but the reduction actually occurs between metallic surfaces. Such a statement may seem elementary, but it is the fundamental basis of grinding in revolving mills, and at the same time marks the point of divergence between the action of cubes and that of balls or rods.

The effectiveness of the crushing between any two adjacent bodies will depend upon three factors: the hardness of the ore, the nature of the force applied, and the character of the surfaces between which the action takes place. Hardness of the ore is beyond control. The nature of the force applied is largely a matter of quantitative energy relationships and depends as much upon the mill characteristics as upon the grinding medium. The character of the surfaces is the factor which heretofore has to the least extent been made the subject of studied design.

For the sake of simplicity in presentation, cubes, balls, or other bodies of compact shape and fairly equal dimensions about their center are taken up first in the present discussion. Elongated bodies, such as rods of cylindrical or polygonal cross-section, will be considered later.

It is pertinent to ask immediately why the sphere was universally chosen in preference to some form of flat-faced polyhedron, when artificial grinding media first began to displace pebbles or other natural media of random shape. The answer seems obvious. Since apparently the medium is subjected to haphazard tumbling in the mill, with no concerted or systematic wear on any particular portion in any particular direction, it seemed safe to anticipate natural action by starting with a rounded shape, as in any event the body would, it was thought, wear round in the mill, or at least would tend to do so. The smoothing and rounding of pebbles and boulders in glacial morain sand in river beds has seemed to be a parallel case. For the many years tube mills have been used, that assumption has been allowed to stand almost unquestioned.

Although a great variety of shapes has been experimented with at various places, the literature indicates

a hope that some advantageous shape would be discovered empirically, without studied attempt to analyze and meet the conditions existing within the mill.

It must be remembered that the feature of essential importance about cubes lies not in the mere circumstance of their cubical shape but in the fact that they are bounded by plane surfaces. By retaining their flat faces throughout their life in a mill, the cubes give evidence of an error in previously existing belief; and indicate that retention of shape is at once an index to the character of the action in progress and proof that bucking-board grinding is possible inside a mill as well as in a laboratory.

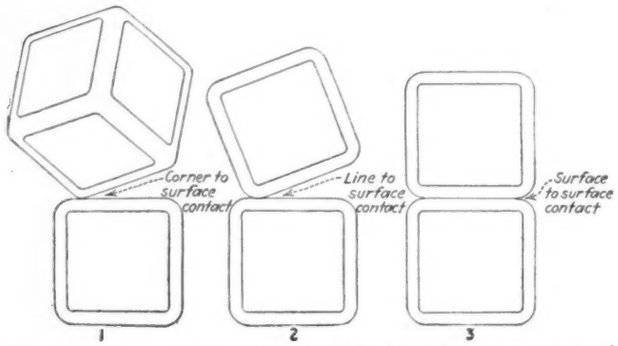


Fig. 1—Illustrating natural adjustment from corner, to line, to surface support.

Consider first the relationships when a descending spherical ball strikes upon another ball, which is either at rest or in motion. The following possibilities exist:

1. The contact may be one of bare steel upon steel, with no ore intervening.
2. A particle of ore may be caught, but not exactly at the point of nearest approach of the balls.
3. A particle may be caught squarely at the point of contact.

The first possibility, the blow of steel on steel, is of course a complete waste of energy, with more wear upon the steel and with as much power consumption as though useful work had been done. The frequency of this type of contact in a ball mill is conjectural; it is shown later in this discussion that the probability of such a contact is very materially reduced when cubes are the media employed. Limitation of the area of contact to a mere point, as between balls, obviously reduces to the absolute minimum the opportunity for a rock particle to be effectively caught between balls.

The second possibility, an inaccurately placed blow, will in all probability result in the particle glancing away, because the surfaces of both balls slope away in all directions from the point of action. A glancing blow may effect chipping and some reduction, but it cannot equal the effectiveness of the third possibility, a squarely delivered blow between two balls with a particle of ore at exactly the one proper point. In this third possibility, the result of the squarely delivered blow will depend largely upon the size of the particle caught. If it be smaller than say ¼ in. in diameter, and the descending ball has had a fall through the radius of the mill, there is excellent opportunity that the force will be out of all proportion to that necessary, and the crushing will be so complete as to amount to sliming of some of the material, which may not be desirable. If the ore fragment is larger than the assumed ¼ in.—it is of course impossible to draw the exact line of demarcation—then conditions are right for the best sort of crushing that is possible, upon the size of feed assumed.

In comparison, consider the relationships existing when a descending cube strikes another cube. Here again there are three possibilities, although their classification is quite different:

1. A corner of one cube may impinge upon any portion of another.
2. An edge of one cube may impinge upon any portion of another.
3. There may be a surface-to-surface contact between the cubes.

In the first case, with impinging corners, the various relationships are for the moment almost identical with those between two adjacent balls. There is a "point" contact, there is the possibility that no ore particle will be caught between the corners, and there is the probability that a "direct hit" will not be registered should a particle be near, but not exactly at, the point of contact. There is only one extenuation for the ineffectiveness of cubes when they strike in point contact, and that is, that a point contact between cubes is as effective as a point contact between balls, and between the latter no other type of contact than the point is possible.[1]

If the corner contact were not the least frequent of the three types possible between cubes, then the cube corners could scarcely avoid being worn off, with rounding of the cube to something resembling a sphere. Furthermore, in the natural process of coming to equilibrium, cubes in corner contact immediately adjust themselves toward a surface-to-surface relationship whenever free to move, for that is the position at rest. The natural course of this equilibrium adjustment is shown in Fig. 1.

The second position of Fig. 1, the edge of one cube impinging upon an edge or surface of another, has a resemblance to the action of short rods. True, in an edge-to-edge contact, the edges must be parallel to give a line contact, but, on the other hand, an edge coming into contact with a surface gives a line contact regardless of orientation. In any event, the edge contact tends to become a surface-to-surface contact, it being the second step in the equilibrium adjustment noted in the preceding paragraph. The edge contact must also be less frequent than the surface contact, since the original edge contour is retained in actual mill service.

The third position, the surface-to-surface contact, the most frequently occurring of the three types, is possible only between bodies having one or more plane faces, specifically, in the present discussion, between cubes. The equality of balls or cubes in point contact is incidental; if cubes prove superior to balls in actual practice it will be because of this inherent distinction of being able to produce a surface contact.

An apparent point against cubes might at first seem to be contained in the foregoing statement, for the law of probability may be cited to show that a freely falling cube has no great likelihood of alighting upon a flat face, and very strong possibility of alighting upon an edge or corner. It must be remembered, however,

[1]It would seem, however, that two spheres would have a greater effective grinding area around the point of contact than would two cubes, meeting in point contact.—THE EDITOR.

that it is seldom that cubes or balls within a mill are literally "freely falling" and that cubes possess the distinction of tending to right themselves by contact with other bodies as above noted. They furthermore begin their cascade or descent from a position of favorable orientation, since the predominant case must be that one axis of the cube is parallel with the axis of the mill at the moment the descent of each individual cube begins, for if this were not true the cubes would inevitably be worn around.

An analysis of the action of cubes, then, resolves itself into an analysis of the surface contact. The most notable points of difference from ball contacts are these:

1. Increased probability of trapping a *number* of particles at every blow, thereby minimizing blows of steel on steel without useful work.
2. A multiplicity of bucking boards, between circumjacent cubes within the body of the mill charge while the cubes are returning to the ascending side.
3. "Selective grinding" — as the surfaces approach each other they are held apart by the coarser material, which must break down before the finer material is touched. (See Fig. 2.)
4. Avoidance of undesirable sliming, through "selective grinding."
5. Wedging action against rock pieces, as surfaces of cubes under pressure approach each other obliquely, or in rotation.
6. Absorption of energy in useful work. Because of the distribution of the area over which the force of any blow is applied, the descending cubes are brought to rest gradually by the progressive crushing of the coarser material, which acts as a brake in absorbing and effectively utilizing all of the kinetic energy of the descending cube.
7. Uninterrupted action between surfaces of cubes under pressure within the cube load, until the material between them is crushed or the pressure relieved.

Increased Probability of Crushing.—The area of one face of a 3-in. beveled cube, as ordinarily used, is 6½ sq.in. If it be assumed that the useful area of the "point contact" between two 3-in. balls is 1 in. in diameter—which is liberal, even with the coarsest feed likely to be encountered—there is then an effective area of but 0.8 sq.in. In actual practice, each ball or cube will of course be in contact with more than one other ball or cube, but that fact does not disturb the ratio, which in this assumed case is roughly eight to one (6½ to 0.8). A 3-in. cast-iron ball weighs about 3.9 lb., and a 3-in. beveled cube weighs about 6.5 lb., so that there will be approximately 1.7 times as many balls as cubes in mill loads of equal weight, and about 1.7 times as many contacts between balls as between cubes will occur, if the ball mill and the cube mill are equal in dimensions and rates of revolution. This, in effect, cuts the surface ratio of cubes to balls from 8:1 to approximately 5:1, although each blow delivered by an individual cube will have nearly double the force of a ball of the same diameter, since it has nearly twice the weight ($E = \frac{1}{2}MV^2$). From all of which it is seen that there is five times the probability that material will be caught between cube contacts, compared with balls of equal diameter, or that the force of impact, which is nearly twice as great, will be distributed over five times the area.

Bucking-board Action. — That a "multiplicity of bucking boards" is at work in a charge of cubes in a mill is a statement which may be taken literally. Since in actual use the cubes retain their original shape, that fact alone is sufficient evidence of the further fact that attrition between plane surfaces predominates, for such cube faces could not be worn down evenly except when grinding is between parallel plane surfaces. Within the body of the cube load, an extremely small relative motion between adjacent cubes would be sufficient to produce this action, and effectively so, because of the heavy weight superimposed.

Selective Grinding. — "Selective grinding" without screening or sizing seems no more an impossibility now than selective flotation did a few years ago. If finished material cannot be removed from a mill the instant it is produced, an attractive alternative is the employment of a shape of grinding medium designed to attack the coarse material in preference to whatever fine material may be present. Fig. 2 illustrates the manner in which the surface contact of cubes tends to accomplish this end. Considering again the 3-in. cube for the sake of explicitness, a surface contact may involve as many ore fragments as may be distributed over the 6.5-sq.in. area of a single face. As two opposing faces approach each other, the thicker of the ore pieces will take the initial effect of the blow or pressure. As these thicker portions break up, progressively smaller and smaller particles hold the surfaces apart, and so the action proceeds until the force of the impact has been spent or until the two cubes are thrown into some other configuration.

Avoidance of Sliming.—Avoidance of sliming, when that end is desired, is a corollary of selective grinding. With the new chemical flotation reagents that are coming into general use, it appears that somewhat coarser grinding can be practiced than was formerly possible

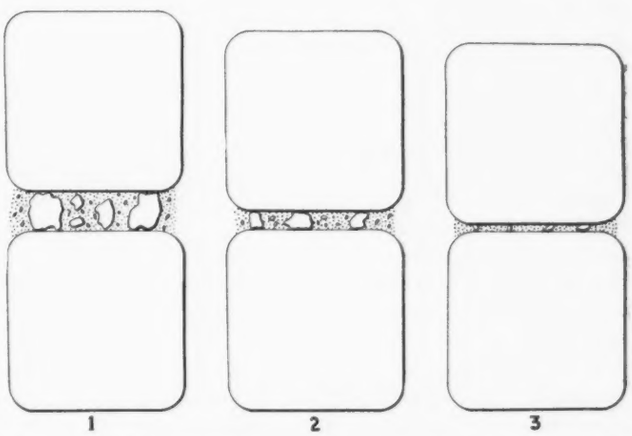


Fig. 2—Selective grinding effect of cubes, the large ore particles protecting the smaller

with oils, with no decrease in the recovery. To grind finer than is necessary for good flotation is not only wasted effort, but the slime so produced may be detrimental both in flotation and in subsequent filtering. The extreme example of the desirability of avoiding slime—in milling cassiterite—has already been noted.

The fact that cubes tend to attack the larger particles first is nevertheless consistent with their use when very fine grinding or all-sliming is desired, as in cement manufacture or in cyanidation. After the larger particles have been reduced, the protection is thereby taken away from the resultant smaller particles, and the latter are then still further reduced by the sliding of the flat cube faces against each other in a direct utilization within the mill of the laboratory bucking-board principle.

Wedging Action of Cubes.—A second type of motion is possible between adjacent cubes, in addition to the bucking-board action. That is the rotation of individual cubes, whereby wedging and pinching of the ore pieces occur. The pressure of the superincumbent load forces the cubes to crowd closely together, for any cube within the charge which happens to be supported by an ore fragment of appreciable size is unbalanced when that fragment gives way, disturbing the inter-related cubes adjacent to it and causing further crushing to be done. Such readjustments between balls within a mill load could not have the same effect, since balls are centrosymmetric and not capable of pinching in on ore pieces in a similar manner.

Continuity of Action.—By a combination of the various effects just cited, the action of the individual cubes is made almost continuous throughout each cycle, as they are thrown down, carried around, lifted, and thrown down again. With a given impact between surfaces, a sufficient number of particles can be trapped so that the resistance offered to crushing by the larger, then the smaller, particles acts as a brake in absorbing and effectively utilizing all of the energy of the blow. Were not so large a surface presented, the lesser number of particles caught at a given contact would either be crushed immediately without regard to size or would be spattered away from the point of contact, permitting the contacting bodies to dissipate their energy on each other. There is necessarily continuity of action between cube surfaces so long as there is material between to be crushed, and there is a tendency for the material to remain exposed somewhat longer, because of the flatness of the surfaces.

No portion of the interstitial space in a cube load is immune from action, but between balls—no matter what their relationship may be—there is always a portion of the interstitial space into which the balls cannot penetrate, because of their shape. When it is considered that a ball or cube, making a single trip down and around say a 6-ft. mill, may travel as much as 10 or 12 ft., it becomes apparent that it is kept out of service a considerable time if not made to work throughout the cycle.

That cubes do give better continuity of action is borne out by the fact that in two mills of equal size, one containing balls and the other containing cubes, equal grinding can be obtained with the weight of the cube charge being 10 to 15 per cent less than that of balls. Even comparing with rods, the weight of the cube charge may be as much as 10 per cent less, as has been demonstrated in practice.

Relation of Impact Area to Impact Force.—It has been seen that for a given set of conditions the effective area of a cube load may be five times that of a ball load, while the force of impact distributed over this greater area is not more than doubled. It is frequently stated by those who favor ball mills that localization of the blow in a single point is advantageous; that a hard, resistant particle might not be broken at all if it did not receive a sharp concentrated blow. That the existence of such a condition is rare may be seen from the following reasoning:

Grinding-mill feed seldom contains an appreciable percentage of material greater than 1 in. in shortest diameter, since any such material, to pass the customary grizzlies, would necessarily be flat, even though of relatively large circumference in one plane. Even, however, granting the presence of large pseudo-spherical fragments, the average size of the balls or cubes used is considerably larger than such fragments; the balls or cubes are of much greater weight because of their size and density, and their "effective mass" is multiplied several times by the kinetic energy of their descent. It is hardly conceivable that the effective mass of a rapidly descending ball weighing say even three or four pounds should not be sufficient to overcome the resistance offered by an inert ore fragment weighing not over a tenth as much. It is possible that a slowly moving ball might not possess the required amount of energy, but any fragment of the size we are now considering would be fortunate indeed if not struck by a rapidly moving body in passing through the entire length of the mill, or if it were not carried to the bottom of the mill and subjected to the pressure of the load above it.

That in practice relatively large pieces are nevertheless occasionally discharged from any mill unbroken may be taken as an indication that the blows they had received, if any, were not delivered properly, rather than as evidence that the blows had lacked sufficient force. A simple experiment establishes this point:

Any piece of ore discharged from a mill without being reduced as much as it should be, may, as an experiment, be laid upon an iron slab, and a ball or cube of the average size in the mill charge may be dropped upon it from a vertical height less than the equivalent of the radius of the mill—say from a height of only two or three feet. It will be found, almost invariably, that any such fragments, even of the hardest ore, are thus readily broken, either by the ball striking them at a single point or by the cube whose blow may be distributed over an area. This seems clear proof that it is not necessary to concentrate the force of impact at a single point and a demonstration that the large fragments, which occasionally do discharge from the mill, by chance have escaped an effective blow, rather than that the grinding media within the mill was incapable of delivering a blow of sufficient force.

Indeed, by this same experiment of dropping a ball or cube by hand upon a piece of hard ore, the concentration of the force in a point is shown to be disadvantageous. Balls, when dropped in this manner, frequently cause the ore fragment to glance away, and a number of drops are often necessary before just the right sort of impact is secured. Cubes, when so dropped, effect reduction at the first blow if one of the flat faces strikes the fragment. If the beveled corner of the cube happens to hit the ore, then the behavior is exactly the same as that of the ball. If an edge of the cube meets the ore fragment, it is as though a rod of similar length had fallen. In other words, the falling cube does no less than equal the performance

of a sphere of equal weight, and its ability to do more is governed by the relative probability that it will strike upon a flat face.

Thus far, comparisons have been between balls and cubes, with little mention of rods. Cubes, to be successful, should be able to replace balls advantageously without alteration of mills or equipment to accommodate the new form of grinding medium. The type of mill best suited to the use of balls has already been established in practice. Analysis of each factor involved indicates that any mill suitable for balls should also be suitable for the use of cubes. In a comparison of cubes with rods, conditions are not so nearly parallel.

Comparison of Cubes With Rods

That cylindrical rods were introduced to extend the point contacts of balls to line contacts is in itself an indication that the point contact was recognized as inadequate. Whether or not their greater unit mass is always an advantage depends upon the size and hardness of the material being ground and consequently the work to be done at each contact. In any event, the mass of each bar is divided over the entire length of its theoretical line of contact. The 3 in. x 12 ft. rods which are used in many large mills weigh 295 lb. each; yet the largest particles they are called upon to crush do not exceed a few ounces in weight; in secondary grinding, the particle weights are matters of only a few grams.

Rods must be parallel to give a line contact. It is not the purpose of the present discussion to raise a question regarding the certainty of always obtaining line contacts with rods. It is worthy of incidental mention, however, that the rods in a roller mill usually show a taper toward the ends as they wear down. It has frequently been noted by operators, too, that primary mills show an appreciably greater power consumption with normal feed entering than when the mill with its rod load revolves without feed. This would be expected in mills equipped with scoop feeders, but is equally true of mills using gravity chute feeders, which consume no power. If the rods are held apart at the feed end by the larger material entering, and yet remain close together at the discharge end where the larger pieces have been reduced, both the rod tapering and the increased power input are explainable by the disturbed rod alignment. Or, again, as the descending rod rolls across the surface of the rod load, the large ore pieces at the feed end might accelerate or retard the descent of that end of the rod, with the same result. The above reasoning is borne out by the fact that similar effects are much less noticeable in secondary mills, where the finer feed cannot hold the rod ends apart.

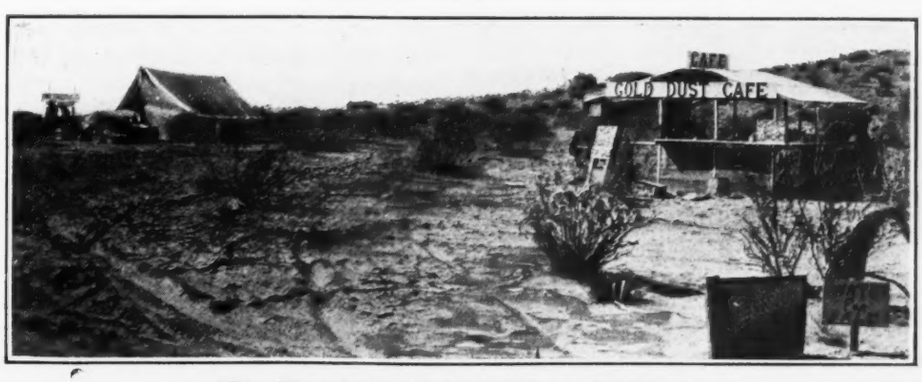
If the comparison in the preceding pages between balls and cubes is correct, then similar reasoning would evolve the rod of square or polygonal cross-section as an improvement upon cylindrical rods. Perfect alignment, however, between rods of polygonal cross-section would be even more necessary than with cylindrical rods, for with the former a whole plane would be reduced to a point or an extremely short line of contact, whereas with the latter the loss is only in the reduction of a theoretical line to a point. There is ample reason to doubt that the necessary alignment could be maintained with polygonal rods; they were not tried at Nacozari because of that fact. I expect, however, to conduct such a test at my present location within a few weeks, there being a sufficient stock of hexagonal rods on hand for that purpose.

One further thought is worthy of mention in this connection: If the area of contact between polygonal rods is seriously decreased by imperfect alignment, the percentage of decrease would be least with the shortest rod possible—that is, one whose diameter and length are equal. Thus the square rod reduces to the cube.

The Range of Cube Grinding

Every crushing machine and every grinding medium has its own characteristic range of greatest efficiency. Cubes may replace rods when the size of feed demands attrition rather than impact, just as in the sample room the jaw crusher, the disk pulverizer, and the buckingboard have their separate fields and supplement each other. Cubes have greater impact capacity than balls of the same diameter, for they have the greater unit mass, but neither one of these has the impact capacity of rods, a fact which is in a measure neutralized by the distribution of rod impacts over greater length and by the fact that cubes or balls would be used in a mill of larger diameter than the usual rod mill. Neither balls nor round rods present *areas* for attrition, and so are handicapped when attrition is desirable. The size of feed and hardness of ore determine whether impact or attrition shall be applied, and when that point is determined, choice of grinding media takes care of itself.

Practice has established that crushing machines accomplish coarse reduction more economically than tube mills, per unit of energy expended. If the crushing plant is as efficient as economy would dictate, the crushing-plant product should be suitable feed for a mill using cubes. If the crushing plant has not reached this efficiency, then in some instances rods may be required to bridge the gap.



The First Cafe in Gold Dust, California

Discovery of Lithographic Stone in Manchuria

By Hironao Nishihara
Mining Engineer, Dairen, Manchuria

THE discovery recently has been made of a deposit of lithographic limestone at a building-stone quarry near a village about 50 km. west of Wa-Fang-Tien, a railroad station about two hours' ride from Dairen, Manchuria. The discovery is the result of intensive search and study of rocks in Manchuria by a young printer by name Shinjiro Yoshimura. He collected and tested fine-grained stones of every description, but he found none to meet the requirements of lithographic stone, until recently. The stone is said to possess all the qualities of the German lithographic stone.

The rock occupies the upper portion of what is generally called green marl; this is placed stratigraphically in the middle zone of Pre-Cambrian series of Manchuria. The thickness varies, but at Min-Chia-Tun and Er-Schu-Li it is between 30 and 50 ft. It has a beautiful light bluish-green color, extremely fine and even texture and conchoidal fracture. Its hardness is between 4 and 4.5 and specific gravity is 2.7. Under the microscope it is made up essentially of nearly equi-areal calcite crystals, which are on an average 0.003 mm. in diameter. The German stone appears similar under the microscope to the Manchurian stone excepting that individual grains are a little smaller and a certain degree of alteration around the crystal grains is plainly noted. The individual strata, whose thickness varies from 1 to 8 in., lie one upon another with a thin seam of clay shale between. Upon weathering the olive-green color gives way to creamy yellow without, however, sacrificing the lithographic property. At Min-Chia-Tun, the strata strike N. 40 deg. E. and dip northwest at angles between 2 and 4 deg. Owing to the fact that practically no jointing, fissuring, intrusion of foreign rocks or disturbances of any kind have developed within the strata, lithographic stone of any desired size, if transportation permit, can be quarried. At Min-Chia-Tun quarries the overlying red marl is almost entirely eroded, and the overburden or soil is only 3 ft. thick.

The reserve of the workable stone has been estimated roughly over 1,000,000 tons at Min-Chia-Tun quarries and at over 10,000,000 tons at Er-Schu-Li-Pu, where working has not as yet been started. Under the present conditions a Manchurian two-pony cart takes a ton, or twelve slabs of stone 2 ft. by 1.5 ft. by 3 in., weighing 200 lb. each, and makes one trip a day from the quarry to the nearest railroad station. Freight from the quarry to Wa-Fang-Tien station costs 4.50 yen (about $2) and to Port Dairen, 6 yen (about $2.70) per ton of undressed stone. Cost of quarrying, transportation, dressing, packing, royalty, management, interest, export duty and handling charges at Port Dairen is estimated at about 16 yen ($7.30) per slab or about $87 per ton f.o.b. Port Dairen.

Before pointing out the high qualities of the stone for lithographic purposes, a description of the art will be helpful. One face of lithographic stone is first ground and polished, washed with clean water and is set in a lithographic printing machine. The face of the stone is then moistened with water and copying paper, containing the matter to be reproduced, is put on the stone. The machine is rolled and pressure is applied. The copying paper on the stone is pressed down thirty or forty times, the paper being moistened each time with a little water. The copying paper is then taken off and the negative print is fixed on the stone. The surface of the stone is then washed with water in which gum arabic has been dissolved. After being dried, the gum arabic is washed away with some clean water. Printing ink is applied, pulverized resin is sprinkled over, and is treated with some water, in which gum arabic has been dissolved and a little nitric acid has been added. It is dried. After the repetition of this process three times the stone is ready to print. This outlines the process generally adopted in lithographic printing in Japan. For finer and more elaborate work engraving or reprinting from electrotype may be resorted to, but the essential principle of lithographic printing is that stone shall possess the property of absorbing fatty substances, which can be worked to adhere to the stone by means of an acid.

Comparative study of the well-known German lithographic stone and this Manchurian stone is of interest. The German lithographic stone, widely known and used all over the country, has a creamy yellow color, hardness of 4, subconchoidal fracture, and a specific gravity of 2.42. For the Manchurian stone it is claimed that:

1. It has a light bluish olive-green color, which gives a pleasing impression.
2. It is harder than other stones; consequently breakage is less.
3. It wears uniformly and lasts longer than others because of its hardness; therefore it is economical.
4. The depth of absorption of fatty substance is much smaller than in the other stones; consequently it takes less time to reface the stone.
5. Finer and more elaborate printings can be made on this stone than are possible with the German stones. This property seems to be due to its greater density.
6. The time required for the preparation of lithograph on this stone is less than on other stones.
7. This stone has a further wonderful property. The reaction is such that when the acid is applied, every minute detail, wherein the fatty substance has been absorbed, can be left free from attack by the acid.
8. If a little glycerine is added to the washing water, it will be possible to produce printing almost equal to the results of collotype work.

It seems possible that this stone will gain a leading place in the lithographic industry, and that South Manchuria will supply large quantities to the rest of the world. I am indebted to Shinjiro Yoshimura for the details regarding his work.

Separating Turnings Saves $20,000 Annually

By using a magnetic device for separating iron and steel from monel turnings when mixed, the General Electric Co.'s plant at Schenectady was able to save approximately $20,000 annually in selling its scrap. Many methods of separating the two kinds of scrap had been tried without success. The magnetic method was not successful, because the monel metal was also picked up. Finally, by using a rheostat on the magnetic separator and reducing the current to a minimum, a point was reached where the iron and steel were picked up and the monel metal dropped. During cold weather the turnings were dried on large steel plates over fires to keep the oil on them from congealing and holding the two metals together.

Discussion

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The Comstock Barren Belt

THE EDITOR:

Sir—The great Comstock Lode of Nevada has been written up from every possible angle in newspapers, magazines, engineering journals, geological pamphlets, and histories. In addition to these we have the reports of the managers and secretaries of the various mining corporations. I have read all of the histories, including the "Big Bonanza," by Dan De Quille, and also a great mass of the other printed matter. I find many facts and much fiction, but not a line with reference to a section of ground about two thousand feet in extent along the lode where no ore of milling quality has ever been discovered. This barren zone is on the divide between the two great mineral-bearing bonanzas of Virginia City and Gold Hill. It lies between the north boundary of the Alpha ground in Gold Hill and the south line of the Chollar company's property some distance south of the junction of E and C streets in Virginia City.

My personal knowledge of conditions on the Comstock was gained in the 60's. I lived in Virginia City and also in Gold Hill, and was familiar with the operations of many of the mines and personally acquainted with all of the superintendents of the various properties. During that period three companies sank shafts on that barren zone. The first was that of the Bullion, which was located to the west and north of the town of Gold Hill. That company continued operations for about thirty years, and the shares were bought and sold on the San Francisco stock board nearly all that time, but so far as I know there is no record of their ever mining or shipping a carload of ore.

The next shaft put down on the edge of the barren belt was that of the Imperial Empire, which was financed by those two Gold Hill companies jointly. That shaft was located east of the lode, as it had been discovered that the great lode dipped east. The work was started in 1866, and I was appointed to take charge of the erection of the hoisting plant and to sink a five-compartment shaft. This was the first shaft to be sunk east of the lode and the biggest at that time. We drove down a thousand feet, cut a station, and ran a crosscut back through the ledge. It was barren of ore.

The next company to make the venture was the New Yellow Jacket, which located its shaft still further to the east. That company constructed the finest and most expensive hoisting plant on the Comstock. They went down nearly three thousand feet, and I learned that they made a crosscut connection with the Imperial Empire on the 2,000-ft. level. While they were running I made the trip through their workings with the superintendent (Captain Thomas G. Taylor), but saw no ore.

Those three shafts were practically on a line with one another, east and west, and in none of them was there found any ore to the north. Later all were abandoned, which is the best possible proof that no ore was found.

I left the Comstock in 1869, and have no personal knowledge of what has occurred there since, and I therefore cannot guarantee the truth of this statement. However, I have the O.K. of an old pioneer newspaper man who spent many years there, which helps some.

Now if this article ever gets into print no doubt some eastern newspaper will send a reporter out here, who will spend an hour or two in Virginia City and write up an article for his publication that will make these facts look like romance. However, I am safe, for they are only alleged facts and not sworn to.

Notwithstanding the fact that in the first forty years the Comstock Lode yielded about six hundred million dollars' worth of gold and silver, the big lode *did* have a lean belt across its middle. R. K. COLCORD.

Carson City, Nev.

Encouragement for Mining Engineers

THE EDITOR:

Sir—A group of prominent educators met a few months ago to formulate some method of encouraging young men in the study of engineering, particularly mining engineering. It was deplored that a drift had set in which bids fair to rob the mining schools of their grist; that in larger and larger numbers new students are taking to commerce, law, medicine, and other pursuits.

The newspapers recently stated that the Bell system is conferring with deans of sixty colleges and universities with the hope of interesting college men in their work with a view to training them as executives. This policy has been pursued by other large corporations of this country, notably automobile manufacturers and steel companies.

The future to which the young mining engineers can look forward, judging by the recent past, is a very minor part in the background of some large company. Salaries are low to start with and increase slowly. competition among "experienced men" is keen, and one who has worked for several years for a large company hesitates to demand more pay with the knowledge that many others are available should he threaten to leave.

It looks as though the influx of young men into the industry and particularly the young men of intelligence —the thinking kind—will come when the industry offers sufficient inducement to them, when the present force begins to receive pay more in accordance with its worth and with what similarly experienced men in other lines are being paid, and when the offering to beginners is more attractive.

To one familiar with the low salaries which mining engineers have been compelled to accept during the last decade, it is gratifying rather than disconcerting to

hear of a possible future shortage in the supply, and that mining companies in the future may possibly have to bid for engineers, instead of having a number in their labor crews from which to pick a favored one for "engineering work."

Though there seems to be a slight improvement in the demand for technical help within the last year, until the salaries offered show a decided improvement it would apparently be better to talk of discouraging new students rather than to try to swell the ranks of those available.

MARK TAYNTON.

Washington, D. C.

Mine Promotion and Mine Financing

THE EDITOR:

Sir—I have read your articles on mine promotion and mine financing with a great deal of interest; and yet the great point remains to be solved: how is the legitimate promoter or operator going to reach the public and how is the public going to know if it will get a run for its money in a property that has a chance for success?

As you know, there are two types of promoters: the real mining promoter who tells the truth and who, most of the time, finds it to be the hardest thing in the world to get money to carry on his work. Second, the fly-by-night promoter who does most of his mining in the pockets of the people and very little in the ground. Of the latter type, if 10 per cent of the money raised goes into actual development work, the promoter considers that he is doing a lot of real mining. How is the public going to differentiate between the two types? To whom is it going for advice?

Now, it is a well-known fact that the American people like to speculate. They are going to, and all the laws that the various states could put on their statute books would not stop them. The blue-sky laws will not solve the problem of getting rid of the bogus mine promoter. It is absolutely impossible to legislate how a man is to spend his money.

The great trouble with many promoters, even if they are honest, is that they know little or nothing about real mining. Often they get hold of a prospect of merit, but they waste so much money in poor management that the property has little or no chance of success. In most cases, if they get a mining engineer to make a report, they never follow his advice. They generally build a mill and install elaborate surface equipment before there is 5,000 tons of ore opened up. The result is, the property is doomed to failure and the men who have financed the scheme in good faith never get a fair and square deal. They were beaten before they started, so to speak. Why is it that most promoters (now I am speaking of those who know little or nothing about mining) consider themselves perfectly competent to direct the operations of opening up a mine or prospect, when, as we all know, to develop a property economically and in accordance with good mining calls for a high degree of ability on the part of the man in charge? Success depends to a great extent upon the management.

It seems to me that the solution of the problem lies with the reputable brokers who operate in our large cities. It is just as legitimate a business to sell stock in an honest and efficiently handled mine development proposition as it is to sell stock in an established dividend-paying company or a government bond.

Remember, the American people are willing to take a chance if they think they are going to get a square deal. The reputable brokerage houses, which now will not consider a development proposition, should handle this class of stock, or, at least, should become more interested. To this they will probably answer: "As most prospects never make mines and as most development propositions never enter the successful dividend-paying class, our clients would gradually lose their money and then blame us, so in the end we should loose their business; therefore, we let that class of securities alone." So today the man with an honest-to-God development scheme has to go elsewhere. However, there is another side to the story. In refusing to handle development schemes, the reputable broker does two things: First, since he will not handle the proposition, the owner, or owners, of the prospective mine have to seek assistance elsewhere, and in many cases fall into the hands of the unscrupulous promoters. Second, since they have left the field for this class of work to the dishonest promoter, the latter has no competition and it is therefore easy for him to get his money. If a number of the good brokerage houses throughout the country carried on their lists some good mine-development propositions that had the earmarks of a mine, with their organizations they could soon give the shady ones a hard run and in the end put them out of business, to a great extent. The business of mine financing could be controlled by the high-class brokers. If the activities of the dishonest promoters were cut down, the failures in mining would greatly diminish. The next question that arises is, how can the established brokers handle these speculative stocks? Now, we all know that, in general, the public's memory is short. The losses that occur through following a broker's advice are far more vivid in the average man's memory than the gains he made. He accepts the latter as a matter of course, but if he loses in many cases he blames his broker. Assume that a group of men have a mining property upon which they have spent some money; they have followed the advice of an engineer and opened up some ore, and the property, with additional development, looks as if it could grow into a mine. They form a company and look for more capital. A brokerage firm is approached to take control and finance operations. The original owners have possibly spent a sum of somewhere between fifty and a hundred thousand dollars; this represents some mine development, buildings, and machinery, and, though the prospect is not yet a mine, it has nevertheless moved out of the straight wildcat class. The brokerage house makes an investigation of the company and especially of its directors, and it may or may not send an engineer to examine the mine. If the company has a report of an engineer, one who is favorably known to the brokers, that will help. Investigation of the company shows it to be a clean, honest one, and the directors are men of standing in their community. If, however, the directors of the company are not men of mining experience, it would be well for the broker to have an engineer examine the property. If the brokerage house takes control, it will then have full charge of the operations and can have the development work done in the best manner. If it does not take over control, but agrees to supply the necessary funds, it can very easily see to it that the money is wisely spent, by an agreement with the company. The broker can have a consulting engineer appointed who has the

authority to direct the development work and who will visit the property from time to time as necessary. The brokers can put the stock before their clients, saying that this is a speculative mining stock; that the property may never become a mine but that they believe that it has a good chance of becoming one; that they have investigated the company and find that it enjoys a good reputation; that its directors are reputable men in their city, or cities; that the company is, and will be, efficiently managed; and that they, the brokers, through their financial agreement with the company, will see that all money is wisely spent; that they, the brokers, can guarantee their clients that they will, at least, get a fair and square deal and with the chances of winning in the ratio of five or ten to one. To impress it upon their clients' minds that they are buying a speculative stock, the brokers might go so far as to attach a printed slip to the stock certificate giving the above information. Then, if the property turns out bad, the clients cannot blame the brokers, for they gave the clients honest information and the latter bought the stock with their eyes open. The printed slip is for the benefit of those with short memories.

If a small part of the money that goes to dishonest promoters each year could be used for legitimate mine financing what a help it would be to the industry, and if the business of promoting mines could eventually drift into the hands of reputable brokers, everybody connected with mining would be greatly benefited.

The public must be educated to know the difference between the good and the bad. It is surprising how easily men who are shrewd and farsighted in their respective lines of business will fall for a lot of hot air put out by promoters, who are unscrupulous or else have no more idea of the value of money than a child has. They seldom investigate, and if they do it is after their money has been spent and not before. Why will men who have made fortunes in their own business do the most foolish things in mining? The real brokers over the country are in the best position to carry on a campaign of education to correct this evil.

Cooke City, Mont. LYMAN H. BROOKS, JR.

The Metric System

THE EDITOR:

Sir—In a paper published in a country which has added the metric system to its other systems of weights and measures an advertisement recently appeared which was inserted by the Executive in connection with the expropriation of land. The land is described as "5 hectares, 15 ares, 85 centiares, and 75 square decimeters," and it is written out in words because the law requires it. The man who advertises the remainder of the lot, however, says "so many square varas."

I have discovered the solution of this discussion of the metric system and its use in the United States. Adam said that many arguments could be avoided if Eve would define her words beforehand. I propose that we define "the adoption of the metric system" as the "use of the metric system to the exclusion of all other systems"; and that anything else be called "the addition of the metric system to those we have." Then I am *for* the individual, voluntary addition, and *against* the adoption. MARK R. LAMB.

Buenos Aires, Argentina.

Ancient Man in Nevada

THE EDITOR:

Sir—On page 1014 of your issue of June 19, 1926, there is a communication from John T. Reid, of Lovelock, Nev., commenting on a reference in your issue of May 29 to the finding of human remains in a soda deposit, 80 to 90 ft. beneath the surface. This salt mine is situated just below Camp Verde, which is about 28 miles from Jerome, Ariz. Mr. Reid states, "One might arrive at the conclusion on reading this article that the remains in question would be very ancient," and continues with an explanation as to how the remains came to be there. His explanation is entirely a feasible one, but his impression as to its being of very recent origin is, I believe, incorrect. Mr. Reid is undoubtedly unfamiliar with the geology of the Verde valley, for if he were familiar with it he would come to the conclusion that the remains are very ancient.

It was my privilege to spend almost a year in north central Arizona, during which time I covered the section of the country in which the soda deposits are located. The Verde valley is about 30 miles wide. It lies between Coconino plateau on the north and the Black Hills on the south. Mount Mingus, the highest point above Jerome, is a little over 7,000 ft. in elevation, and the plateau to the north is the same.

The elevation of the Verde River is a little over 3,000 ft. just below the salt mines. The river has cut through an old lake bed, whose deposits are over 1,100 ft. below the present river bed, as shown by well borings. The shores of the ancient lake, which extended from the Sycamore Canyon to below Camp Verde, 45 miles away, are well defined. This lake was formed by the damming up of the ancient Verde River by the range of hills below Camp Verde. Before this happened the view of the Verde Canyon from the plateau must have been similar to what the Grand Canyon of the Colorado is today from El Tovar. A trace of its former grandeur can be observed from the top of Schnebly Hill.

The lake remained long enough to fill up the deepest part of the canyon about 1,500 ft., when periods of drought came, and the lake dried up. When this happened, and our ancient larva eater was safely incased in his sarcophagus of salt, no one knows; but it was long ago. Since this happened the Verde River and its tributaries, Sycamore, Oak, Beaver, and Clear creeks, have cut into the lake deposits from 150 to 700 ft.

Along the banks of these streams are the remains of cliff dwellers, probably descendants of the Mayas, who archeologists say are at least 2,000 years old or more. I have seen the walls of these canyons that are covered with picture-writings and paintings that have withstood the ravages of time. I have seen stone implements weighing 25 lb. or more which have been excavated from this same soda deposit. These, I believe, are now in the Smithsonian Institution.

What is the age of this man whose remains have just been brought to light? It is unfortunate that the skull was crushed by the steam shovel that found the skeleton, for it might have made the Neanderthal man and the ape-man of Java appear very young.

The Doheny Expedition found the painting of a dinosaur on the walls of the Hava Supai Canyon, about 100 miles to the northwest. Possibly this ancient man could tell us who painted it. MILO W. KREJCI.

South Orange, N. J.

News of the Week

The Mining News given in ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

SHOSHONE COUNTY, Idaho, is spending three million dollars per year in prospecting; work started on Kellogg zinc plant; Yukon Gold discontinues dredge on Prichard Creek, Idaho.

Premier and Big Chief zinc mines, Joplin-Miami district, sold—Oklahoma first-aid team wins trip to San Francisco.

Boulder Tungsten pays $62,500 dividend—Promising gold-silver discovery near Topley, B. C.—Assay office established at Port Arthur.

Bureau of Mines organization chart as of June 30—Influx of Mexican labor—Lower freight rate promised for Arizona ore.

Kingdon lead mine, Galetta, Ontario, producing seven to nine million pounds per year.

Copper Export Association membership to include 90 per cent of world's copper production—South African gold industry demanding government aid—Golden Horseshoe mine closed indefinitely—Potash combine raises prices.

Consolidated Coppermines makes twenty-year contract with Nevada Consolidated for marketing ore—Unwatering Kay Copper mine.

Drilling program at New Cornelia increases ore reserves—Aravaipa Mining Co. installing mill.

Dome Mines installing machinery at Red Lake—Saskatchewan to make mineral survey.

U. S. arsenal explosion, Lake Denmark, N. J., damages Mount Hope mine of Replogle Steel Co.

Eagle-Picher Lead Co. May Soon Pass Into Control of A.S.&R.

Negotiations are pending whereby the American Smelting & Refining Co. may acquire control of plants and mining properties of the Eagle-Picher Lead Co.

John B. Swift, president of the Eagle-Picher Co., on his return to Cincinnati, July 9, from New York, stated that he had met the officers of the Guggenheim corporation and held several conferences. It will require a month or more before the negotiations have gone far enough to know whether the deal will be accomplished, but on the basis of present indications it is likely to be consummated.

Officials of the American Smelting & Refining Co. state that negotiations have not gone beyond the preliminary stage.

There are also rumors that the Sherwin-Williams Co. and the National Lead Co. are negotiating for the Eagle-Picher properties.

The Eagle-Picher company owns extensive mines in the Joplin, Mo., district and at Picher, Okla. It has manufacturing plants located at Cincinnati, at East St. Louis and Chicago, Ill.; Picher and Henryetta, Okla.; Joplin, Galena, Kan., and Newark, N. J.

The company is one of the oldest of its kind in the country. The Eagle White Lead Co. was established in 1883 and in 1906 took over the Picher Lead Co., an Oklahoma corporation. In 1916 the two were merged into the Eagle-Picher Lead Co. with Oliver S. Picher as president. Following his death two years later Mr. Swift, who was chairman of the board, succeeded him.

The Eagle-Picher Lead Co. was incorporated under the laws of Ohio about June 1, 1916. In addition to its mines and smelting plants, it owns gas and oil fields and a gasoline-absorption plant in Oklahoma.

Since 1919 the Eagle-Picher has taken over the Hammer White Lead Co. at East St. Louis, the Midland Chemical Co. and the Ontario Smelting Co. It also owns a majority of the voting stock of the Consolidated Lead & Zinc Co.

Capitalization of the Eagle-Picher consists of $855,500 authorized 6 per cent non-cumulative preferred, $100 par, $855,300 of which is outstanding, and $20,000,000 outstanding $20 par common stock.

Consolidated Mining & Smelting Increases Production

The Consolidated Mining & Smelting Co. of Canada has announced that its output for the first half of this year was 61,265 tons of lead, 29,849 tons of zinc, 5,461 tons of copper, 26,726 oz. of gold, and 3,306,359 oz. of silver. This compared with a production of 45,682 tons of lead, 15,711 tons of zinc, no copper, 8,179 oz. of gold, and 1,595,983 oz. of silver during the first half of 1925. The increased production of all metals is due to an increased production of ore throughout the Kootenays, better concentration conditions at the Sullivan mine, and better metallurgical conditions at the smelter. Operations at the smelter were hampered during last year by the additions and alterations that were being made in all departments, and the heads of the several departments were occupied in supervising the alterations.

Two Mines Added to Shipper's List on Mesabi Range—Other Activities

Two more mines on the Mesabi range were added to the list of shippers for this season when the St. Paul mine of the McKinney Steel Co., Keewatin, Minn., started production with its 350-ton electric shovel on July 1, while the Wade mine of the Cleveland-Cliffs Iron Co., at Kinney, Minn., started shipping its stockpile on July 6. This is the first ore the Wade mine has shipped in two years.

Near the Prairie River in Sec. 3 T. 55 R. 25 the Charlson Exploration Co., of Hibbing, Minn., is sinking a new exploration shaft for P. H. Nelson, two miles west of Coleraine, Minn.

Due to a broken 90-lb. rail, thirty-seven cars of iron ore were recently scrambled up on the Nashwauk division of the Great Northern Railway near Coleraine, Minn., forming the worst wreck of the season. This caused no delay to ore traffic, however, as all trains on that division were routed through Kelly Lake instead of Grand Rapids.

With the majority of the big stripping operations on the range completed, the large stripping contractors are moving most of their equipment to other states. The Winston Dear Co., Hibbing, Minn., shipped a Model 300 shovel, cars, and locomotives to the Howard County Mining Co., Russell, Mo., where they have a contract to build a coal tipple, strip and load out coal, and build the railroad yards.

Ore shipments have reached normal, and with the present demand for pig iron the outlook for the season is good.

Kingdon Lead Mine, Galetta, Ontario, Financed by Own Production—Development Campaign Begun

By Our Special Correspondent for Northern Ontario

ONE of the most interesting and at the same time little-known mining operations in Ontario is that of the Kingdon Lead Co., at Galetta. The property comprises about 1,300 acres on Chats Island at the junction of the Mississippi and Ottawa rivers. It is in the center of a beautiful agricultural country, about one mile from the village of Galetta and only 40 miles by motor highway from Ottawa. The property was acquired about fifty years ago by the James Robertson Co., of Montreal, and in 1885 a shaft was sunk to a depth of about 25 ft. and a few feet of drifting done. The shaft was put down on the only surface exposure, and indicated galena in fair quantities.

A crystalline limestone in which are intruded large masses of diorite is the country rock. The vein, which dips at about 80 deg., occupies a fault fissure which has the characteristic swells and pinches, and though it lies mainly in the limestone, there does not appear to be any change in mineralization when it passes through the diorite. The vein material is calcite, and the lead occurs as galena irregularly distributed. Ordinary sampling methods will give very little idea of the average grade of the ore. The galena, which carries practically no silver, is very pure, there being very little pyrite, zinc or other metallic minerals. Though the ore in the original small shaft was comparatively high grade, the average of the vein is about 5 per cent.

The property was idle from 1885 to 1914, when A. G. Munich, of Montreal, decided to open it up. This required not only vision but courage, because there was no lead mining in eastern Canada. The property was remote from other mining districts, and there was no Canadian lead-mining experience to draw on. The shaft was deepened and a small amount of development done, and then a small mill was built. High-grade concentrate was produced, but it was found that the cost of marketing absorbed all the possible profits. The new company was faced with the necessity of smelting its own ore, if it wished to survive, and after a good deal of experimenting an 8-ft. Scotch hearth with a Newman mechanical rabble was installed. Later a blast furnace was built to re-treat the slag. From the time of the installation of the Scotch hearth the output has steadily increased. Aside from the original sum raised, practically no new money has been subscribed and the property has made its own way and financed enlargements and improvements. In 1918 the company was reorganized and transferred to the Kingdon Mining, Smelting & Manufacturing Co., of which A. G. Munich is the managing director.

The mine has a three-compartment vertical shaft which has just reached a depth of 1,150 ft. One compartment is used for hoisting men and materials. The skip compartment has a separate hoist for handling the ore. Levels are driven at 125-ft. intervals, the longest level being 2,500 ft.

The vein varies in width to 14 or 15 ft., but the average is from 6 to 8 ft. It swells and pinches, and the stopes are opened up between the pinches, the longest stope in the mine being 1,320 ft. The longest pinch so far encountered is about 175 ft. The vein material being calcite, it drills very easily, but on account of the tendency of the holes to bootleg when blasted, a large number of holes is required. This results, however, in the ore being broken fine. Ore is now being drawn from the 650, 775, 900, and 1,025 levels.

A remarkable feature of this mine is that no exploratory work has been done, and there are practically no waste dumps. No crosscutting or diamond drilling has been required, and the drifts have been carried only a short distance beyond the end of the stopes. All work has been confined to the known ore, this policy being dictated by the financial requirements of the company. The mine has paid its own way, including all improvements and enlargements. There is, however, every reason to believe that drifting on the vein will open up other oreshoots. No reason is apparent why much greater depth should not be obtained, and there is also the possibility of parallel veins. The only change with depth has been a lengthening and widening of the vein, with no apparent change in grade.

The company has now reached a stage when this work will be done. Present production is 400 tons a day, and within two months this will be raised to 800 tons. A new ore hoist and a three-ton skip are being installed and another 800-ft. compressor has been ordered. When these installations are completed, the company plans to begin a campaign of exploration.

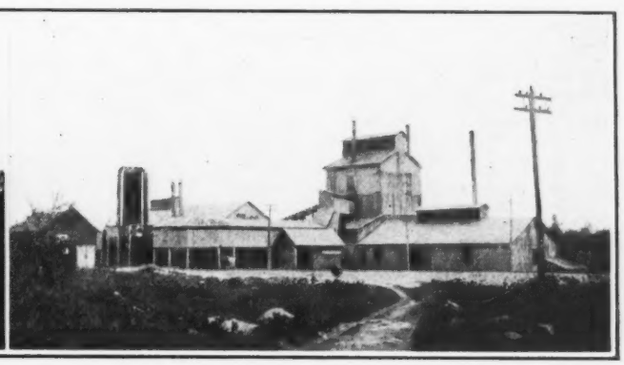
In the smelter building there is an 8-ft. continuous syphon overflow Scotch hearth with a mechanical rabble. The smelter fumes pass through goosenecks and a flue to the baghouse. The furnace is not so much a smelting as a reducing unit. Production of lead by the Kingdon company last year was over 7,000,000 lb., but at present it is about 15 tons a day, although a record run for a Scotch hearth, of 25¾ tons in 24 hours, has been made.

The ease, simplicity, and economy with which the hearth is operated is due in a considerable measure to the grade of the concentrates. A Scotch hearth will not operate efficiently on concentrates running under 68 per cent lead or over 2 per cent silica. The Kingdon concentrates run 80 per cent and over and are very low in silica, zinc, and silver.

The company is privately owned; no report is made public and costs are not published. Inspection of the property and plant is, however, sufficient to show that costs are low, and that they will be substantially reduced when the increased tonnage is being treated. The mine and mill is in charge of R. R. Rose, and the smelter in charge of J. U. MacEwen, and the high degree of efficiency throughout the property is a tribute to their management.

Ore reserves are believed to be 250,000 to 300,000 tons, and with a campaign of exploration under way these should be quickly augmented.

Shaft house, conveyor building and mill, Kingdon mine, Galetta, Ontario



Smelting and refining plant, Kingdon mine, Galetta, Ontario

Denouncements Increase in Number in Mexico

According to statistics published by the Mexican Department of Mines, 3,176 petitions for mining concessions, involving 39,722 hectares of land, were filed with that department in 1925, compared with 2,011 such petitions, covering 25,006 hectares, in 1924.

News From Washington

By PAUL WOOTON
Special Correspondent

Bureau of Mines Organization as of June 30 — Influx of Mexican Labor—Engineering Advice vs. Copper Tariff

AS SOME CONFUSION has been occasioned by the discussion of the reorganization plans of the U. S. Bureau of Mines, Director Turner has outlined the organization as in effect June 30, so that the changes which have been in contemplation for some time may be discussed more intelligently.

The present organization includes the following divisions and offices:

Divisions

1. Mining Experiment Station, Technological Branch, D. A. Lyon, supervisor of stations.
2. Metallurgy, Technological Branch, D. A. Lyon, chief metallurgist.
3. Fuels, Technological Branch, O. P. Hood, chief mechanical engineer.
4. Petroleum and Natural Gas, Technological and Executive branches, H. H. Hill, chief petroleum engineer.
5. Mining research, Technological Branch, J. A. Davis, acting engineer in charge.
6. Safety Service, Technological Branch, R. R. Sayers, acting chief engineer.
7. Mineral Technology, Executive Branch, F. L. Hess, engineer in charge.
8. Helium, Technological Branch, R. A. Cattell, engineer in charge.
9. Mineral Resources and Statistics, Executive Branch, F. J. Katz, engineer in charge. (Transferred to Bureau of Mines by Executive order June 4, 1925.)
10. Coal Division of the Bureau of Foreign and Domestic Commerce, Executive Branch, C. P. White, chief. (Placed under the supervision of the Director of the Bureau of Mines on Jan. 1, 1926, by order of the Secretary of Commerce.)
11. Office of Chief Clerk, Administrative Branch, J. D. Secrest, chief clerk.
12. Information Service, Administrative Branch, C. E. Julihn, engineer in charge.

Offices

1. Chief Surgeon's Office, Technological Branch, R. R. Sayers, chief.
2. Chief Explosives Chemist's Office, Technological Branch, C. E. Munroe, chief.
3. Mine Safety Board reports to Director George S. Rice, chief mining engineer, chairman.

MEXICAN LABOR MIGRATING TO THE UNITED STATES

Mines in nothern Mexico are experiencing an excessive turnover among their laborers due to the unprecedented migration of Mexicans to the United States. Mine workers drifting up from the interior furnish a good supply of recruits, but in most instances their stay is only long enough to accumulate sufficient funds to continue the trip to the United States, where they are attracted by the wage scales and the reports as to the satisfactory working conditions that they have had from friends or relatives already here.

The U. S. Department of Labor estimates that Mexicans have been entering the United States this spring and summer at the rate of 10,000 per month. A part of these are harvest workers, who will return, but the Mexican employees in industrial centers of the North and East are increasing rapidly, with all probabilities pointing to their permanent residence. Manufacturers are beginning to learn—as many American mining men long since discovered—that the Mexican peon, under proper direction, is a faithful and capable worker.

ENGINEERING ADVICE VS. TARIFF ON COPPER

Announcement that the Michigan copper producers are turning to outside engineering advice in an effort to devise means for the continuance of mining operations on as large a scale as possible is hailed as evidence that they now are placing reliance in a more promising quarter than that of the protective tariff.

If some method can be found to concentrate more general attention on the Michigan problem, it is believed that a way will be found to keep those mines in production, because the copper is there. It is largely a question of devising means of going deeper at costs that will leave a profit. No one in Washington is inclined to blame the Michigan producers for their previous attitude toward the federal government's technical bureaus. The impression created long ago when inexperienced men were sent into that country has been hard to live down. It is believed, however, that cordial relations now have been established and that these bureaus will be able to be helpful in the present situation.

Editor's Note:

The above Washington letter reflects certain views of official Washington. Due to the fact that policy as a rule prevents government officials from permitting their views being quoted directly, the authority for these reports is necessarily somewhat vaguely referred to. The views reflected from time to time are not those of any one group of officials, but of different men, in the legislative and executive departments. There is no necessary connection between their views and "Engineering and Mining Journal" editorial policy; neither do they necessarily represent Mr. Wooton's personal views. It is felt that the opinions thus faithfully reflected will be of great interest to the industry.

Where opinions are cited from sources outside of the government, the source will be specifically stated.

Prospecting Not Dead in Idaho; $7,000,000 Spent in Three Years

The sum of $3,083,166 was expended in Shoshone County, Idaho, last year in search for mineral treasures and the development of those found, according to a survey and compilation by Ravenel Macbeth, secretary of the Idaho Mining Association. Virtually all of this expenditure was in the Coeur d'Alene region.

In 1925 the number of producing but non-dividend paying companies was 17, as compared with 4 in 1923. In all, $7,056,188 has been expended in the last three years in search and development. Dividend-paying companies are not included in the details. The 1925 expenditures were as follows:

Non-Producing Development

Labor	$ 804,712
Supplies	360,564
Mine equipment	53,195
Mill equipment	11,570
	$1,230,041

234 companies employed 424 men.

Producing, Non-dividend

Labor	$1,071,241
Supplies	534,338
Mine equipment	56,400
Mill equipment	73,198
Tramways	4,000
Ore transportation	104,948
	$1,853,125

17 companies employed 564 men.
251 companies employed 988 men.

1924 Expenditures

246 non-producing development companies expended	$1,161,777
9 producing non-dividend paying companies expended	876,008
Total	$2,037,785

255 companies employed 739 men.

Expenditures in 1923

267 non-producing development companies expended	$1,438,419
4 producing non-dididend paying companies expended	498,818
Total	$1,935,237

271 companies employed 763 men.

The cost of assessment work on unpatented mining claims and of location work on new mining claims is not included in the foregoing statement of expenditures for 1923, 1924, and 1925.

Lead Discovery Reported at Fort Scott, Kan.

Interesting stories of lead strikes in the vicinity of Fort Scott, Kan., have recently come in, but are not credited seriously by operators in the Joplin-Miami district. The lead is found in shale, and it is not believed by operators in the Joplin field that shale ore deposits ever amount to much.

Premier Zinc Mine Sold

Arrangements have virtually been completed for the purchase of the Premier mine, in the Joplin-Miami district, by the Chicago Mines Corporation. The Premier has been owned jointly by the Tri-State Mining Co. and the Kanok Metals Co. It is understood the consideration was in the neighborhood of $200,000. The lease consists of eighty acres in the heart of the Picher, Okla., camp. Originally the Premier had only forty acres, but it recently acquired forty acres more. Both properties have been operated steadily since 1918, and much of the ground is mined out. A. M. Gaines, manager of the New Chicago Co., estimates there are close to 1,700,000 tons of tailings on the two properties that will show recoverable values.

Much of the mining at the two properties was carried on in 1921, 1922, and 1923, when it was imperative for a company to get a large tonnage. This made the matter of close recoveries of less consequence, and most of the tailings have been proved rich in mineral content. The Premier mill will be rebuilt to handle tailings exclusively.

Lower Freight Rates on Arizona Ore

Substantial reductions in freight rates on ores and concentrates in Arizona are proposed in an application recently filed with the Arizona Corporation Commission by the Southern Pacific R.R. Co. On $15 ore the new rates will be as follows: One cent per ton per mile up to 200 miles; nine mills per ton per mile from 200 to 350 miles; eight mills per ton per mile for distances over 350 miles, with a minimum rate of $1 per ton for ores under $15 per ton. On ores in excess of $15 per ton in value the rate will be increased by adding 30c. a ton for each increase in valuation of $10 until a value of $150 is reached, after which there is no increase in the rate. The application also proposes similar reductions in the interstate rates to El Paso.

Mount Hope Mine (N. J.) Damaged by Arsenal Explosion

The Mount Hope mine, Mount Hope, N. J., owned by the Replogle Steel Co., Dover, N. J., was seriously damaged as a result of the U. S. Navy arsenal explosion at Lake Denmark, N. J., on July 10, at 5.20 p.m., when lightning struck a TNT magazine. The damage to the mine is unknown, as the entire area is under military control and surveys cannot be made until later in the week. At the arsenal, nearly all of the 200 buildings were destroyed. Naval officers state that more than $80,000,000 worth of TNT, smokeless powder, and big-gun shells had burned or exploded At least twenty-one persons were killed, ten are missing and 200 or more were injured. The shock was felt many miles distant. The fire was still burning on July 13, minor explosions continuing.

Sumpter Smelter May Resume

Announcement of the intention to start the Sumpter smelter in Oregon, closed down since 1923, has been made by officers of the Northwestern Smelting & Refining Co., Sumpter, Ore., which recently purchased the property, valued at more than $500,000.

The plan is now to spend $50,000 in repairing the plant for operation early this fall. The capacity of the boilers will be increased, a sintering plant installed, and other machinery added.

Dome Mines to Install Equipment at Red Lake

It is officially announced that the Dome Mines, Ltd., will without delay install a mining plant at the company's Howey property in the Red Lake area of northern Ontario. When diamond-drilling operations were undertaken it was with the view that if a 20-ft. width of $8 ore was indicated the installation of a mining plant would be justified. The width of ore at the 300-ft. horizon exceeded the 20-ft. minimum originally estimated. It is intended to have the equipment delivered at Pine Ridge before the lakes freeze over. A winter road 45 miles long from Pine Ridge to Red Lake will be used in hauling the machinery to the Howey.

Membership in Copper Export Association to Embrace 90 Per Cent of World's Production

Officials of one of the largest copper-producing companies have confirmed the report that an announcement of the formation of a new organization uniting the copper producers of the world in foreign markets under the Webb-Pomerene law can be expected soon. Details connected with the formation of the new association are being perfected by the leading companies concerned. Only a few legal formalities remain to be adjusted.

The companies understood to be active in the new organization are the Anaconda Copper Mining Co. and its affiliated concerns, Phelps Dodge, Kennecott, Cerro de Pasco, Calumet & Arizona, Calumet & Hecla, Magma, United Verde Copper, United Verde Extension, Copper Range, American Metal, American Smelting & Refining, and Howe Sound.

The association will unite producers of about 90 per cent of the world's copper. It is understood that a different name from the one originally chosen, that of Copper Export Association, will be selected.

Aravaipa Mining Co. Installing New Mill

The Aravaipa Mining Co., Lewis Douglas, president, with mines at Aravaipa, Ariz., is assembling the machinery for a flotation mill. For the last several weeks machinery for the mill has been unloaded at Cork siding and hauled out to the mine on the Klondyke road. Practically all the machinery is on the ground now, and foundations for the mill are under construction. It is the expectation that the mill will be in operation by the end of the year.

During the progress of the development work, shipments of approximately eight cars of high-grade ore have been made to the smelter at El Paso. The office of the company is in Phoenix, Ariz.

Baxter Mining Property Sold

The Baxter Mining Co. property, located just south of Baxter Springs, Kan., in the Joplin-Miami district, has been purchased by J. H. McNivens, of Chisholm, Minn., A. J. Harrington and Frank Clayton, of Carthage, Mo., and St. Louis associates. Price is unofficially reported at $116,000.

McNivens and Harrington operated a drilling option on the property for several months, and before that it had been a good lead producer. Considerable improvement to the mill is planned by the new owners.

Saskatchewan to Make Mineral Survey

The government of the Province of Saskatchewan, Canada, will make a complete survey of the mineral possibilities in that province this summer. Investigation of coal deposits and other mineral resources in Lac La Ronge is at present being made by a party in charge of C. B. Hastings, mining engineer and geologist.

Diamond Drilling at New Cornelia Finds New Orebodies

It is reported that the diamond-drilling campaign started by the New Cornelia Copper Co., Ajo, Ariz., is resulting in the finding of new ore. To date more than 200,000 tons of copper ore, averaging 0.90 per cent copper, is said to have been added to the reserves. Ore of this grade can be successfully treated at the company's new concentrating mill. The upper 300 ft. of one of the drill holes showed copper ore averaging 1.98 per cent.

Consolidated Coppermines Sells Ore to Nevada Consolidated

An agreement has been reached between the Nevada Consolidated Copper Co. and the Consolidated Coppermines Corporation at Ely, Nev., whereby the Nevada Consolidated is to handle the production of the Consolidated Coppermines to a maximum of 3,000 tons per day for a period of twenty years. This transaction is considered one of the most important consummated in the Ely district for years. It gives the Consolidated Coppermines a market for its ores, and, as the two properties are contiguous, will expedite operations at the Nevada Consolidated. The Nevada Consolidated has developed a large deposit of heavy sulphide ore on its property adjoining the Minnesota claim of the Coppermines that is known to extend into the latter claim.

Assay Office Established at Port Arthur

The Ontario Department of Mines has decided to establish an assay office at Port Arthur, the equipment for which has already been sent forward. The new office will be in charge of A. L. McEwen, of Port Arthur, a mining engineer of some experience and a graduate of the Royal School of Mines, London, England. The establishment of this office will be a convenience to those concerned in the revival of mining in the district.

Unwatering of Kay Copper Workings Started

Unwatering of the old workings between surface and the 600 level of the Kay Copper Co., at Canon, Ariz., is now under way. A diamond-drill hole is to be put down from the No. 8 level of the present workings, to tap the old No. 6 level. This work is in line with recent instructions from President Godfrey that all immediate efforts be confined to delimitation of known orebodies, to determine the most economical process of reduction.

Wrigley Makes Shipments

Mining operations continue active at the Wrigley properties on Catalina Island, off the port of Los Angeles, Calif., from which 200 tons of silver-lead concentrates were shipped to the Selby smelter the first of July and 200 tons of zinc concentrates on the French liner "Montana" on July 3, destined to smelters in Belgium.

American Zinc Purchases Big Chief Mine

The American Zinc Co., a subsidiary of the American Zinc, Lead & Smelting Co., has purchased the Big Chief mine of the S. R. & W. Co., in the Joplin-Miami district, for $128,000. The mine has a new mill in place of one destroyed a few months ago by fire. It was considered a failure during the post-war slump, and was taken over by Homer Seals, J. W. Roberts, and Will Walker, of Joplin, from which came the name, S. R. & W. At that time the old company had $25,000 in outstanding bills, and it was taken over by the creditors, who sold it to the three mining men. It has since been a good producer. The S. R. & W. Co. also took over the Hartley mine, in the Baxter Springs district, after it had been abandoned by the Chanute Spelter Co., and sold it to the Hutcheon Management Corporation for $300,000. The same property is now valued at more than $600,000.

John T. Craig, of Baxter Springs, Kan.; Carl Meyers, of Joplin, Mo., and a Kansas City associate have purchased the Black Eagle Mining Co.'s No. 1 mine, located near St. Louis, Okla., in the Joplin-Miami field. Repairs to the mill are being made before starting operations. It will be operated under the name of the Bonnie C. Mining Co. The consideration involved was not made public.

First-Aid Team Wins Trip to San Francisco

In a close contest held at Miami, Okla., July 4, the Golden Rod Mining & Smelting Co.'s No. 2 first-aid team won the annual district meet by a margin of one point, and as a reward will be given a free trip to San Francisco, to participate in the national meet to be held there this fall. Members of the winning team include Henry Blanton, captain; Raymond Skinner, Delmar Dafis, Willis Hopkins, Hoyle Kearns, and Earl Ehrenman. The winning team scored a total of 597 points out of a possible 600, and the team of the Consolidated Lead & Zinc Co. scored 596 points and won valuable prizes of merchandise, offered by the merchants of Picher.

Team No. 1 of the Golden Rod company and team No. 2 of the Commerce Mining & Royalty Co. tied for third place, with a score of 592. A coin was flipped, and the Golden Rod team won the place.

Several thousand people attended the contest, and much interest was shown. The general work of the contestants showed marked improvement over that of a year ago.

Work on Horse Mesa Dam Begun

Pouring of concrete for the base of the Horse Mesa dam, on the Salt River between Roosevelt and Phoenix, Ariz., has been started and is progressing rapidly. When the dam is completed it will be 300 ft. from the bottom of the foundation to the top of the spillway gates. The top of the parapet wall will be six feet above that. Maximum thickness at the base will be 57 ft. At the top the thickness will be 8 ft. The top length of the arch is 500 ft. The dam will have two spillways, the one on the north end having six 27-ft. gates and the one on the south side three, giving a total length of free spillway of 243 ft. Three 8-ft. penstocks pass through the dam, with their center lines 43 ft. above bedrock, through which water will be discharged for the generation of 40,000 hp. of electric power, under a head of 270 ft. The total volume of concrete required for the dam and power house will be about 155,000 cu.yd.

Gold-Silver Discovery Near Topley, B. C., Promising

Preliminary surface exploration of the new find near Topley, B. C., indicates that probably it is the most important discovery that has been made in British Columbia in recent years. The deposit has been examined by Douglas Lay, resident provincial mining engineer for No. 2 Mineral Survey District and formerly general manager of Le Roi No. 2 mine, at Rossland, who, though emphasizing that as yet sufficient exploration has not been done to enable him to form an opinion of the extent of the deposit, considers that the existing indications point to the discovery being one of unusual promise.

The deposit is on Black Mountain, 8½ miles from Topley, a station on the Canadian National Railway about 100 miles east of Smithers. Mr. Lay describes the deposit as occurring near the junction of the rhyolitic tuff and andesite. The mineralized zone is 150 ft. wide, and may be more, as mineralization penetrates into the andesite. It is exposed for 300 ft. along a creek, and has been traced for another 300 ft., where it disappears beneath drift. The precious metals occur in lenses and stringers, composed chiefly of galena and arsenopyrite, the silver probably being associated with the former and the gold with the latter. Samples taken indicate that the full width of 150 ft. will assay $20 in gold and silver per ton, the value of the silver content usually being slightly higher than that of the gold. On the surface the mineralized zone is so soft that it may be possible to mine it with a steam shovel.

A number of claims has been staked on what is believed to be the general trend of the ore zone, and three camps already have been erected. F. H. Taylor, the discoveror, who has eight claims, has started a tunnel across the deposit.

White Hills Silver to Sink 1,000-Ft. Shaft

The White Hills Silver Mines, Inc., Chloride, Ariz., has completed the construction of half a mile of truck road from the main highway to the collar of the new shaft. The company is now bringing in heavy timber, hoist, compressor, and other supplies in preparation for sinking to a depth of 1,000 ft.

Lessees working on the G. A. R. mine of the company's holdings are reported to have sent two shipments of ore to the smelter which assayed $85.53 and $465.59 per ton in gold and silver. J. K. Turner, of Los Angeles, is president of the company.

Yukon Gold Discontinues Dredge on Prichard Creek

The Yukon Gold Co., which had been operating a dredge on Prichard Creek, in the Coeur d'Alene district, Idaho, for the last ten years, has closed down, having reached the limit of pay ground. Prichard Creek flows through a wide canyon with numerous gulches, which were profitably worked by early-day placer miners, but the main creek did not have sufficient fall to permit hydraulic mining. About six or seven miles of the creek was acquired many years ago by the Coeur d'Alene Placer Mining Co., control of which was held by Boston people. Failing to work out any successful plan for recovering the gold, the placer company leased the ground to Yukon Gold. A dredge which the company had used in Yukon Territory was brought to the Coeur d'Alenes, and for about ten years has been digging its way up Prichard Creek, starting about three miles below Murray and ending about three miles above, leaving windrows of gravel and boulders across the wide canyon and encroaching on the old town of Murray. What disposition will be made of the dredge has not been announced.

Work Begun on Electrolytic Zinc Plant at Kellogg

The construction of an electrolytic zinc reduction plant at Kellogg, Idaho, by the Sullivan Mining Co. is the most important enterprise that has been undertaken in this district within recent years, in fact since the establishment of the Bunker Hill lead smelter at Kellogg. The Coeur d'Alene district has long ranked as one of the chief sources of lead supply in the United States, but it is only within comparatively recent years that zinc production has reached a position of importance coincident with the development of the flotation process. Zinc associated with lead is widely distributed throughout the district, and in some mines, notably the Callahan, Constitution, Sidney, Success, and Star, zinc predominates.

The primary purpose of the Sullivan company in building the zinc plant is to provide treatment for the zinc product of the Star mine, which has now been developed to a point that insures production on a basis of 500 tons of ore per day, and also to treat the zinc ores of Pine Creek and other parts of the district. Its initial capacity will be fifty tons of metallic zinc per day. It is evident now, though not officially stated, that the output of the Star will be sufficient to maintain this initial capacity, and since there is quite a large custom business in sight, particularly from Pine Creek mines, it is believed more than probable that the Sullivan company will find it necessary to increase the capacity, possibly before the original plant is completed.

Excavation for the zinc plant is proceeding, but it is estimated that it will require a year to place it in operation. This long time will be required for the delivery of the electrical equipment rather than for actual construction. The plant will be located on Government Gulch, a short distance south of the

Bunker Hill lead smelter. The Tainton electrolytic process will be used, having high acid strength and high voltage density. The inventor of this process, U. C. Tainton, assisted by Wallace Woolf, metallurgical engineer, has been engaged for several years in perfecting the process through practical tests in an experimental plant in connection with the Bunker Hill & Sullivan company at Kellogg, which have conclusively demonstrated its success if not its superiority over other electrolytic processes. The Tainton process has also been subject to exhaustive tests by independent metallurgical engineers, with equally satisfactory results.

Boulder Tungsten Company Pays Dividend of $62,500

The largest single dividend ever paid by a mining company in Boulder County has been placed in the mails for stockholders of the Boulder Tungsten Production Co., Boulder, Colo. The checks total $62,500 and represent earnings from the mines and mill of the company since the first of the current year. The dividend comes as an echo to the boom days of the World War, when this county sprang into prominence as one of the leading producers of tungsten. The company controls 16,000 acres of tungsten land in the Nederland section, 18 miles west of Boulder. It represents in large part the Rogers tract and former holdings of the Vanadium Alloys Steel Co., which were operated during the war under the name of the Vasco Mining Co.

The Boulder Tungsten Production Co. is employing sixty men in its mines and mill. The mill is running one shift a day, putting through an average of fifteen tons. Concentrates average about one ton per day. Since Jan. 1 the company has made regular shipments of a car of concentrates a month.

Coincident with announcement of the dividend, President Clark stated that a strike of new ore had been made on the 700 level of No. 6 mine, two miles below Nederland. It is deemed especially significant in view of the fact that ferberite deposits of value at that depth have been very rare in this county.

Last Chance Mine Making Regular Shipments

The Last Chance mine, near Lordsburg, N. M., recently purchased from Robert F. Fitz, of Los Angeles, Calif., by Montgomery and Allison, of Lordsburg, is being opened up rapidly by the new owners. A new compressor has been installed and a six-ton ore truck is making six round trips daily to the railroad at Lordsburg. Two hundred and fifty tons of ore taken from the 275 level is now in transit to the Phelps Dodge smelter at Douglas, Ariz. Thirty miners are at work under W. C. Montgomery, superintendent. The smelter sheet of 50 tons of ore shipped May 10, being the second car, shows the ore to run 100.72 oz. silver and 1.24 per cent copper. A new power plant will be installed soon, and a new mill of probably 100 tons' capacity, to handle the milling ore, will also be installed. Estimates are being received for this new equipment.

Johannesburg Letter

By John Watson

Special Correspondent

Decreased Profit for Rand Mines, Ltd., in 1925—Gold Industry Demanding Government Aid

Johannesburg, June 8—The following crushing results for the month of May from fourteen leading Rand gold mines have recently been published. The mines are arranged in order of profits earned:

	Tons Crushed	Value or Revenue £	Costs per Ton s.	Costs per Ton d.	Estimated Profit £
Government Areas.....	188,000	351,216	16	2.6	200,596
New Modder...	132,000	293,998	18	9.1	170,199
Crown Mines...	237,000	304,810	17	9.1	94,351
Modder Deep...	44,200	99,661	15	3.0	65,900
Springs.....	67,700	127,385	19	7.2	61,036
Brakpan.....	89,500	143,215	18	5.0	60,812
Modder B.....	69,500	119,247	17	11.9	56,718
New State Areas	75,000	132,682	20	8.4	55,347
Van Ryn Deep..	68,600	105,844	16	5.1	50,150
Geduld.....	83,000	120,113	17	0.0	49,599
City Deep.....	103,000	154,601	22	2.2	40,341
Randfontein Estates.....	212,000	210,947	16	11.5	33,494
West Springs...	49,000	75,991	18	9.8	29,893
Robinson Deep.	76,000	.....	18	4.9	28,666

The annual meeting of the Rand Mines, Ltd., was held in the Corner House, Johannesburg, on June 3. The chairman, Sir Evelyn Wallers, announced a profit for the last year of £616,196, a decrease as compared with the previous year, due chiefly to the loss of premium on gold, caused by the return to the gold standard. He gave a comprehensive review of the present position and prospects of the gold-mining industry. The use of jackhammer drills on the mines of the group has been further extended, and their efficiency has been considerably increased by the utilization of improved drilling methods, the betterment of the quality of drill steel supplied, and the replacement of older machine drills by up-to-date types. Though the industry is achieving ever-increasing efficiency, it is handicapped by a policy, on the part of the present Union Government, which Sir Evelyn described as "disturbing and the reverse of helpful." Attention is being directed to the fact that the beginning of the decline of this great industry is near at hand. A committee, appointed in March, 1924, reported upon means of stimulating the development of the mineral resources of the Union. The Government Mining Engineer, Sir Robert Kotze, was chairman of that committee, and the report was published over a year ago. Valuable recommendations then made have, up to date, been neglected by the present government. Reference was made to the interests of Rand Mines, Ltd., in the Victoria Syndicate, Ltd., operating in Canada, the Anglo-Spanish Construction Co., Ltd., which is building the Santander-Mediterranean Railway, and also to the North Venezuelan Petroleum Co., Ltd., an oil-prospecting venture of considerable promise. The company's interests in platinum in the Transvaal were also detailed.

On the Johannesburg Stock Exchange during the last week gold shares have improved and their prices, generally, are higher. London has been buying Anglo-Americans, Consolidated Diamonds, Consolidated Main Reefs, and Modder B. Government Areas improved during the week from 170s. to 175s. New Modders are slightly higher. Brakpans rose from 77s. to 80s. Sub-Nigels have again been largely dealt in, and closed the week at 31s. 9d. T. C. Lands have been in only moderate demand at about 51s., Onverwacht Platinums were largely dealt in and closed the week at 17s. per 10s. share.

French Imports of Zinc Ore Increase in 1925

Imports of zinc ores into France in 1925 totaled 170,458 metric tons, compared with 137,740 tons in the preceding year, according to the U. S. Department of Commerce. Receipts of raw material, pig, bars, or plates declined to 44,201 metric tons in 1925 from 61,159 tons in 1924. Belgium-Luxemburg was the principal source of French imports of the last-named products; the United States was second, and Germany third. Imports of zinc sheets totaled 736 metric tons in 1925, a considerable decline from the 3,375 tons received in the preceding year. Imports of filings and waste dropped to 1,432 metric tons from 2,012 tons in 1924.

New Aluminum Plant to Open in September

The Aluminum Company of America will start production at its new Saguenay River plant (Canada) in September. Its ores will be obtained from the company's mines in South America. The advantage of duty-free shipments to the United Kingdom was a factor in the plant location, but it is now expected that part of the output will be exported to the United States.

Sumitomo Producing 3,000,000 Lb. Copper per Month

The Sumitomo Goshi-Kaisha, a copper company at Osaka, Japan, reports the following production: March, 1926, crude copper, 2,815,453 lb. yielding 2,548,324 lb. of refined copper. April, crude copper, 2,739,544 lb., from which the refinery produced 3,076,926 lb., this total representing, in part, accumulations.

Silver From the Quincy Mine

The rich east lode in the Quincy mine, at Hancock, Mich., which is being opened at the 87th or bottom level of No. 2 shaft, where it is 12 ft. wide and as heavily charged with copper as it is at the 86th, also contains considerable silver. Silver is characteristic of the Pewabic series. For some time, Quincy has been experimenting with methods to increase silver recovery in the mill treatment. A small Tyler Hummer vibrating screen is now in use, for separating the different sizes of copper and silver mineral, the larger percentage of silver falling with the fines. The coarse material is fed on to a moving belt, from which the silver is hand picked. The installation has increased the recovery of silver, which netted the company a profit of $53,600 last year. A considerable proportion of this metal, however, still is lost.

London Letter

By W. A. Doman

Special Correspondent

Much Prospecting in Rhodesia—Chrome Ore in Demand

London, June 29—Prospecting and developing on a large scale are in progress throughout Northern and Southern Rhodesia, Nyasaland, Tanganyika, and Portuguese East Africa, and reports are daily coming to hand of discoveries and mining progress. M. D. Caldwell, manager of Tanganyika Goldfields, is putting up a plant of 800 to 900 tons' monthly capacity. Gold values of 12 dwt. per ton over 4 ft. are reported on one property. This company has secured twenty diamond claims near the Tanganyika Diamonds area, which appear promising, and Mr. Caldwell has also located alluvial tin deposits along the Uganda border, samples of which have been assayed in London, showing 72.5 per cent tin.

Though Edmund Davis is well pleased with his concessions in Northern Rhodesia, W. Selkirk, who has also visited the properties, was rather guarded in his remarks at the recent meeting of the Southern Rhodesia Base Metals. He emphasized the fact that although the company's huge areas contained prospects worth development, they are only prospects and should be considered as such until sufficient work has been done to prove the value of the sulphide ores. This refers especially to copper deposits, though on the Copper Queen a small orebody assays 2.8 per cent copper, 4.7 per cent lead, and 6.4 per cent zinc.

Chromium in Demand

The importance of chrome in the manufacture of stainless steel and iron is gradually becoming more widely recognized, and the occurrences of the mineral in various parts of the world are receiving increased attention at the hands of prospectors and exploration companies. Rhodesia supplies more than 50 per cent of the world's production, and the value of the output increased from £245,000 in 1920 to £337,000 last year. Prospecting activity has resulted in the pegging of the record number of 64,000 claims in 1925, and American interests associated with the Vanadium Corporation are said to have acquired an option on some 5,000 claims in the Banket-Darwendale area north of Salisbury. In this connection, it is interesting to note that a prospector employed by the Zambesia Mining Development Co. has located chrome north of the Zambesi, so that apparently the deposits of Rhodesia extend into Portuguese territory.

Placer Gold in Northern Spain

The Dome Mining Corporation, Ltd. (Spain), which launched its dredge with a great flourish of trumpets about twelve months ago, is very reticent as to results. From time to time it has been stated that the dredge, which is of the Netherlands type, was working well, but no gold returns have been published. However, a new concern called the Dredging Development Co., has now made its appearance, and the Dome people are interested, as they have the right to appoint two directors. The nominal capital of the company is £75,000, which is not much more than would be required to erect a dredge. It is proposed to install one of the powerful Californian type, as after working about nine months the old dredge has been found quite unsuitable. It appears that the original plant was designed to dig to a depth of 30 ft. only, whereas the richer gravels are below this depth. The "various firms of mining engineers" who originally inspected the property vouched for an average depth to bedrock of 18 ft., but although a depth of 67½ ft. has been attained, there is still no bedrock. Also the ground is too hard and compact for the original plant. The new dredge will, it is said, be capable of digging to 80 ft. The question which is being asked is why it has taken such a long time to discover these grave mistakes.

Potash Combine Raises Prices

With reference to published accounts attributed to the Franco-German Potash Sales Agency, denying the existence of a potash monopoly, the U. S. Department of Commerce states that there could be no question as to the monopolistic character of the Franco-German Potash Syndicate since it controls over 90 per cent of the world's potash trade. The United States, its best export market, absorbed during 1925 about 14 per cent of the Franco-German sales of 1,700,000 short tons of pure potash. These importations into the United States constitute about 90 per cent of the potash consumption.

The signing of the first pact in August, 1924, was destined to put an end to competition between the two producing countries. Before this pact was signed, prices were, in the opinion of the trade, considerably above any level justified by efficient methods of production. Furthermore, contrary to the recent press statement of the potash sales agency, prices have been raised since the new pact was formed, thereby increasing the American potash bill by from $500,000 to $1,000,000 annually.

The Department of Commerce will, in any event, proceed with the exploration of the Texas potash deposits as authorized by the last Congress.

Graphite Production Increased in 1925

The U. S. Department of Commerce announces that during 1925 the establishments engaged primarily in the grinding and refining of graphite reported a total output valued at $2,569,487, an increase of 17.6 per cent as compared with 1923, the last preceding census year. Of the 11 establishments reporting 3 are in Pennsylvania and the remainder in California, Illinois, Michigan, New Jersey, New York, Ohio, and Texas. Statistics for 1925 are summarized in the following statement:

Number of establishments	11
Wage earners (average number)	228
Maximum month, March	237
Minimum month, December	216
Per cent of maximum	91.1
Wages	$278,224
Cost of materials (including fuel, mill supplies, and containers)	$1,328,188
Products, total value	$2,569,487
Primary horsepower	2,927

Melbourne Letter

By Peter G. Tait

Special Correspondent

Golden Horseshoe Mine Closed Indefinitely—Tin Discovered on King Island, Bass Strait

Melbourne, June 14—The Golden Horseshoe mine, at Kalgoorlie, has closed down owing to the shortage of funds. The Western Australian Government has already financed the company to the extent of £50,000 by guaranteeing a bank overdraft, and the general manager, J. W. Sutherland, is now negotiating with the government for further assistance. A general review of the position of the company was included in my letter published in the *Engineering and Mining Journal-Press* May 1, 1926, and there is little to add to that statement. Probably the present action has been taken under advice from the directors in London with a view to reconstruction. Additional capital is necessary because of the failure to keep development well ahead of ore extraction. The prospects of the mine are excellent, and there is little doubt that the shareholders who are now compelled to face the situation will agree to find the necessary funds.

The Australasian Shale Oil Co., at Latrobe, Tasmania, has had a trial run with the first unit of the Bronder retort, and it is claimed to have been satisfactory. Although operating below full capacity, it produced about 400 gal. of oil during twenty-four hours.

Duncan McNab has reported favorably on a new tin field discovered on King Island, in the Bass Strait, between Tasmania and the mainland. The property is held by the Sea Elephant Prospecting Association, of Melbourne, the shareholders of which comprise some well-known names in the mining world, including Bowes Kelly, of the Broken Hill and Mount Lyell companies. The tin occurs both in alluvial and lode, and the test figures show the deposits to contain from one to three pounds of tin per cubic yard.

Essington Lewis, who succeeded G. D. Delprat as general manager of the Broken Hill Proprietary Co. on his retirement some years ago, has now been appointed managing director of the company. Mr. Lewis, after graduating at the Adelaide University and the South Australian School of Mines, joined the staff of the company twenty-one years ago. He served for a time at the company's silver-lead smelting works at Port Pirie and also at the mine at Broken Hill, and then came to the head office in Melbourne as assistant to the general manager. He was closely associated with the development of the company's iron and steel enterprise at Newcastle.

In my last letter reference was made to the murder of two detectives at Kalgoorlie who were investigating gold thefts at the mines and mills. Investigations by the detective staff have resulted in the arrest of a Kalgoorlie hotel keeper and his barman, who have been remanded. Further arrests are anticipated.

Situation at the Mines

By Albert H. Fay
Assistant Editor

THE slight increase in the price of the major metals has had a stimulating effect on the development and production branches of the industry, with the possible exception of copper. Producers of copper feel that the price is still too low, some contending that a tariff is the only remedy. However, it must not be forgotten that nearly every copper mine is equipped to such an extent that it can easily produce

Average Prices, January, 1926, to June, 1926

Period	In Cents Copper	Lead	Zinc	Silver
Average, 1925	14.042	9.020	7.622	69.065
January, 1926	13.822	9.255	8.304	67.795
February	13.999	9.154	7.759	66.773
March	13.859	8.386	7.332	65.880
April	13.706	7.971	7.001	64.409
May	13.599	7.751	6.821	65.075
June	14.656	8.033	7.112	65.481

more copper than a normal market can consume. The consumption of copper is increasing continually and new uses are developing, but the monthly production capacity is a few million pounds in excess of normal requirements.

Probably one of the most important features in the copper industry is the amount of prospecting and development which is taking place in Northern Rhodesia, where a number of companies have prospecting concessions amounting to thousands of square miles each. In the Rouyn district of Quebec progress is being made in the construction of the railroad to the new mines, and foundation work for the smelter is well under way. Important copper discoveries have been reported from Albert County, New Brunswick, Canada, and considerable interest is manifested therein. In Mexico the Greene Cananea Consolidated Copper Co. is testing, by a series of drill holes, a new copper deposit which has been found in the Democrata property. The merger of the Ray-Nevada companies has been completed, so that the new organization is now in full control of the consolidated property. Calumet & Arizona has increased its divdends to $1.50. The Central Copper Co. is developing a town site at Dos Cabezas, Ariz., in connection with its mine operations. Arizona copper shipments have recently been made via Los Angeles and the Panama Canal to Eastern refineries at a saving of $1 per ton. The production of the Anaconda Copper Mining Co. is approximately 16,000,000 lb. per month. In Nevada, the Mason Valley mine and mill are in operation, shipping ore and concentrate to the smelter, which will probably go in blast in August. Calumet & Hecla, in Michigan, has practically completed the installation of its modern equipment and is now in a position to produce copper on a larger scale than ever. The prospects at the Quincy mine, in Michigan, are improving as developments proceed. Refined copper production in the Michigan district in June is estimated at 14,950,000 lb.

Due to the usual labor turnover at this time of the year, some of the Michigan mines are short of miners. Men are coming into the district, but a considerable number of underground workers take employment on farms or other surface work during the summer. Copper Range, Quincy, Isle Royale, and Ahmeek are in need of miners.

Gold—Prospecting and developing is proceeding apace in the Red Lake district, with about 5,500 mining claims staked, covering an area of approximately 300 square miles. The two large companies, Dome and McIntyre, have had drills operating for several weeks. It is understood that good results have been obtained, and there is an optimistic feeling over the development work conducted at Red Lake. The Hollinger Consolidated Gold Mining Co. is now treating one million tons of ore per year and is planning extensive development below the 3,000 level. At Quartz Mountain, Nev., there has been a moderate gold rush, and many claims have been staked and sold at fancy prices.

The monthly production in the Tonopah, Nevada, district is approximately 186,300 oz. of bullion, valued at $161,700. The Tonopah Mining Co. and the Tonopah Belmont Development Co. have a combined production of 112,000 oz. per month; the West End 47,300; and the Tonopah Extension, 27,000. This represents normal production for these companies during recent months. Conditions in Tonopah as a whole remain unchanged. Settlement of the apex litigation between the Tonopah Extension and West End and its affiliated companies by agreement out of court releases some known ore and permits resumption of development in very promising territory.

Lead-Silver—The sale of the Western Lead stock was recently prohibited on the Los Angeles exchange by order of the State Corporation Commission. Immediately following this, D. C. Julian, president of the company, instituted suit against the *Los Angeles Times* and the State Corporation Commission for alleged damages. The Utah Lead-Silver Mines are in a prosperous condition, some paying extra dividends while others are paying increased dividends. Increased prospecting activities in some of the older mines are resulting in adding materially to the production. In the Mayo district, Yukon Territory, Canada, steady production is under way and regular shipments are made.

Conditions in the Coeur d'Alenes are better than for a long time. The large properties are being operated at capacity and employing large forces. Towns of the region reflect prosperous mining conditions. Recent advances in the price of lead have added to the feeling of confidence.

The Presidio Mining Co., at Shafter, Tex., a subsidiary of the American Metals Co., is planning the construction of a 300-ton cyanide mill. A flotation plant of 250 tons' capacity is now under construction by the International Smelting Co. at Rico, Colo.

Zinc—In the Joplin-Miami district production decreased somewhat by reason of lower prices in May, but with the increase in prices the latter part of June production is again on the rise. The Admiralty Zinc Co., Douthat, Okla., is unwatering the mines in the old Belleville camp near Joplin. In the Joplin district the new mills that are being constructed are now of steel. These displace the old wooden type of mill. Whether or not this innovation will be carried out in all new construction remains to be seen.

The Polish zinc industry is increasing its production to a considerable extent, and the Polish Government has at last ratified the Harriman-Anaconda purchase of the Von Geische mines. On June 17, it was officially announced that a 50-ton electrolytic zinc plant at Kellogg, Idaho, will be built as soon as work can be started. The cost will be about one million dollars. In British Columbia the Consolidated Mining & Smelting Co. has recently contracted for the shipment of 16,000 tons of zinc concentrate to Europe, shipments having already begun.

Iron—Lake ore shipments for the month of June have been heavy, although the lateness of the season delayed an early start. Additional men have been taken on by the Oliver Iron Mining Co., and production is proceeding at a rapid rate. The same company has 35 locomotives at work in its Missabe Mountain mine, at Virginia, Minn. The Minnesota royalty tax law has been held constitutional. On June 15, the Minnesota mining companies paid into the State Treasury $2,317,270 as state tax. In British Columbia there is a possibility of an iron industry being established by a British syndicate. The Bethlehem Steel Co., of Bethlehem, Pa., is also interested in British Columbia and has recently opened an office at Vancouver.

General—In Nevada a 50-ton sulphur plant is being installed at Humboldt. The Southern Pacific Railway is cataloging all of the non-metallic mineral deposits of California, Arizona, and Nevada with the idea of advertising these minerals and thus developing a market for them. In California and other Western states the quicksilver mines are increasing production, and there is some prospecting to open up other possible deposits. A number of new quicksilver furnaces have been installed by various mining companies. In Utah, a carbon-black plant is now under construction at Cisco by the Cisco Carbon Co., utilizing the natural gas from the wells in the immediate neighborhood. In the Malayan tin fields the suction dredges have been pronounced a failure and are being reconstructed to operate as bucket dredges. There is by reason of the high price of tin much prospecting under way in the Malayan states as well as in Cornwall and Bolivia.

Societies, Addresses, and Reports

Unique Course in Mine Administration Planned in Arizona

Metal-Producing Companies and State University Will Co-operate—E. P. Mathewson Director of Work—Field Study Important Feature

THE College of Mines and Engineering of the University of Arizona will offer during the academic year of 1926-27 a course in the administration of mineral industries which contains a number of unique features. The plan is to offer to well-qualified men an opportunity to equip themselves for relatively rapid advancement to administrative positions in mines, mills, and smelters. E. P. Mathewson, widely known economic metallurgist, who joined the faculty this year, is to be the supervisor of the course. The requirements for admission as set forth in a recent announcement are:

1. The candidate must have received at least a bachelor's degree in mining engineering or metallurgy from an institution of recognized standing.

2. He must have enjoyed several years of successful experience since graduation from college. The length of time that must have elapsed since graduation will depend upon the nature of his experience and other factors, but a minimum of three years has been tentatively established.

3. He must be selected and highly indorsed by his employers to enroll in the course. A searching investigation will be made into his qualifications, and only men who by their attitude and accomplishments have demonstrated that they possess such personalities and executive ability as will probably enable them to become successful administrators will be permitted to register. It is believed that peculiar qualities must be possessed by men who succeed in administrative work, and that many men so endowed will eventually work their way upward into administrative positions even though they may never especially prepare themselves for such work. It is the sole object of this course to give such men certain training and opportunities, in the belief that they may thus advance more rapidly and prove more valuable to their employers.

4. The candidate must sign a statement to the effect that if, after graduation from the course, he re-enters the employment of the company for which he was working prior to taking the course, he will accept a position at no higher rank and carrying no higher salary than the one he previously filled. It must be explicitly understood by all concerned that his subsequent advancement will be entirely dependent upon how much he profits from the course. In other words, the diploma or degree will be worth little or nothing; it is demonstrated ability that alone will count.

5. If he has not already studied introductory economics and bookkeeping, either while in college or afterwards, before registering for the course, the candidate should procure and read the following books: The first 190 pages of Guthermann's "Analysis of Financial Statements," Bye's "Principles of Economics."

6. He must make application for admission to the course prior to Aug. 15, giving the data outlined on a circular entitled "Information for Applicants," which may be obtained from the Dean, College of Mines and Engineering, University of Arizona.

The course will run through one college year of approximately nine months. It will comprise five months of formal study of economic subjects on the campus of the university, and four months of field work on the properties of different large mining or smelting companies in Arizona. The campus and field work will alternate, the first month being spent on the campus, the second in the field, etc.

Nature of the Campus Work

Students who have not already studied equivalent subjects will be required to enroll for the following courses:

First Semester

Course	Units
Administration seminar (Dr. Mathewson)	2
Econ. 131a—Advanced Accounting	3
Econ. 141—Business Finance	3
Econ. 171a—Business Organization, Administration, and Management	3

Second Semester

Administration seminar (Dr. Mathewson)	2
Econ. 131b—Advanced Accounting	3
Econ. 148—Money and Banking	3
Econ. 171b — Business Organization, Administration, and Management	3

Additional units to a minimum of thirty may be selected from upper division or graduate courses listed in the university catalog, of which the following are especially recommended:

First Semester

Course	Units
Law 20a—Business Law	3
Econ. 181a—Principles of Sociology	3
Econ. 210a—Seminar in Economics	2
Econ. 130—Business Statistics	3
Econ. 105—Labor Problems	3

Second Semester

Law 20b—Business Law	3
Econ. 181b—Principles of Sociology	3
Econ. 210b—Seminar in Economics	2

The feature of the course will be the "Administration Seminar." The first month will be spent in preparing the students for the field work in which they will later engage. The work that they will do will be outlined, the problems they are to study will be set forth, the observations they are to make discussed, and the conditions existing in the various mining camps of the state described. During the third, fifth, seventh, and ninth months the students' reports upon the field work completed will be read and discussed.

The students will go in pairs to the various mining camps, where they will be given opportunities to study in detail the operations of great mining and smelting companies. They will study the plans of organization, the accounting systems, methods of handling supplies, bonus systems, social and economic conditions, attitude of employees, welfare work and all other related matters.

While the field work is under way the supervisor of the course will visit in rotation camps where the students are located and do everything in his power to see that they are gaining the maximum benefit from their work.

Upon the return of the students to the campus, they will be expected to submit exhaustive reports of the observations made during the preceding months. They will also meet for several extra periods with the campus instructors to review the work in the campus courses that has been covered in their absence.

It is tentatively proposed to limit the class to twelve men. If more than this number apply, it is probable that only the twelve men who appear to be best qualified will be admitted.

It is estimated that the necessary expenses of a student who takes this course need not exceed $625 a year for a resident of Arizona, or $725 a year for a non-resident of the state. These figures are based on the following estimated costs:

Incidental and hospital fees	$30.00
Room rent in Tucson (nine months)	135.00
Room rent outside of Tucson (sixteen weeks)	80.00
Board in Tucson (on campus)	125.00
Board outside of Tucson	140.00
Stage or railroad fares	37.00
Books	25.00
Notebooks and stationery	10.00
Barber bills (if student shaves himself)	3.00
Laundry bill	30.00
Drugs	5.00
Diploma fee	5.00
Tuition fee (paid by non-residents only)	100.00

The following Arizona mining and smelting companies have agreed to permit students to study their operations in detail, and officials of these companies will give the students as much aid as they are able to render:

Calumet & Arizona Mining Co., Warren and Douglas.
Copper Queen Branch, Phelps Dodge Corporation, Bisbee and Douglas.
Inspiration Consolidated Copper Co., Inspiration.
International Smelting Co., Inspiration.
Iron Cap Copper Co., Copper Hill.
Miami Copper Co., Miami.
Morenci Branch, Phelps Dodge Corporation, Morenci.
Old Dominion Co., Globe.
Ray Consolidated Copper Co., Ray and Hayden.
United Verde Copper Co., Jerome and Clarkdale.
United Verde Extension Mining Co., Jerome and Clemenceau.

Upon the satisfactory completion of the course, the degrees of Engineer of Mines (E.M.) or of Metallurgical Engineer (E.Met.) will be conferred upon the members of the class. It is possible that new degrees, Master of Mining Administration (M. Min.Ad.) or Master of Metallurgical Administration (M. Met.Ad.) will be created and conferred upon such members of the class as prefer them to the professional degrees mentioned.

Full information may be had on application to the Dean, College of Mines and Engineering, University of Arizona, Tucson, Ariz.

People You Should Know About

A Werner Lawson, of Washington, D. C., was in New York during the week ended July 10.

Dr. Kuno B. Heberlein has just returned from an extensive trip through Mexico, the Pacific Coast, and the Western States.

Sam Hugh Brockunier is making examinations in western Ontario for a syndicate represented by Kirby Thomas, of New York.

T. G. Otley, chief mechanical engineer to the Victoria Falls and Transvaal Power Co., Ltd., returned to Johannesburg from England on June 1.

Edwin A. Sperry, professor of metallurgy at Pei Yang University, Tientsin, China, is at Marysville, Calif., on his vacation, and will return to China in August.

A. W. Newberry, mining engineer, is now in Southern Rhodesia examining gold properties. Mrs. Newberry sailed from New York on July 8 to join her husband.

F. L. Ransome, professor of economic geology at the University of Arizona, is conducting some geological work for the Ahumada Lead Co. at Los Lamentos, Mexico.

Louis E. Reber, geologist at the United Verde mine, Jerome, Ariz., has resigned to accept a position with an English mining syndicate in Rhodesia, South Africa.

George Mitchell, president of the Columbia River Gold & Copper Co., recently left Redondo Beach, Calif., for the State of Washington and Canada, to examine copper properties.

Arthur Curtis James and **Walter Douglas,** director and president respectively of the Phelps Dodge Corporation, are making an inspection of the company's holdings in the Southwest.

S. F. Shaw, mining engineer, will be engaged for the coming two months by the Roxana Petroleum Corporation in consultation work on designs of air lifts and gas lifts in Oklahoma oil wells.

Dr. J. Yokobori, formerly president of the Akita Mining College, was recently in New York City. He will visit the Sesquicentennial Exposition at Philadelphia at the beginning of August.

Frank A. Bird, metallurgical engineer of Salt Lake City, has gone to Tlacotepec, Guerrero, Mexico, to erect the first unit of an amalgamation-concentration-cyanidation mill for the Cia. Minera El Gigante.

Frank Reeves, of the Geologic Branch of the U. S. Geological Survey, is engaged in geologic mapping in the Highwood Mountains of Montana. He is assisted by **R. H. Haseltine,** and his headquarters are at Fort Benton.

Allen H. Rogers, of Rogers, Mayer & Ball, left New York on July 3 for Peru to be absent about two months, and **Sydney H. Ball,** of the same firm, recently returned to New York from Rouyn, Quebec, and left on July 8 for Peru.

R. V. Ageton, safety engineer for the Tri-State Zinc & Lead Ore Producers' Association, attended the accident-prevention conference held in Washington on July 14 and 16. He also will attend a meeting of the Federal Board for Vocational Education, to be held at Blue Ridge, Va., Aug. 18 to 28.

H. D. Hunt was recently appointed mill superintendent of the Miami Copper Co., Miami, Arizona, to succeed **F. W. Solomon,** who resigned June 15. Mr. Hunt is a Colorado School of Mines graduate, and entered the employ of the Miami Copper Co. in March, 1911.

Photo by Gregory L. Oliver.
H. D. Hunt

He has served the company in the capacities of chief chemist, experimental engineer, metallurgist and now becomes mill superintendent. Intensive study of the milling and metallurgical problems of the Miami Copper Co. has eminently fitted him for his new position.

Obituary

Frederick C. Peters, manager of the du Pont company's New York office, died on June 30. He was fifty-three years old.

"Micky" Ronan, formerly connected with the Calumet & Arizona Mining Co. as an engineer, who left Arizona in 1922 to accept a similar position with a Belgian mining company on the West Coast of Africa, died recently of tropical fever.

W. F. Wallers, elder brother of Sir Evelyn Wallers, died in Johannesburg on June 2. He was born in England sixty years ago, and was in business in Durban until 1914, when he joined the co-operative exchange in Johannesburg. He leaves a widow and grown-up children.

N. L. Heinz, of River Forrest, Ill., died suddenly on June 17 from heart disease while on his way to his summer home at Lake Geneva, Wis. Mr. Heinz was consulting engineer for the Donora Zinc Works of the American Steel & Wire Co., and had built roasters for the Mineral Point Zinc Co., at De Pue, Ill.; a sulphuric acid plant for the Ducktown Sulphur, Copper & Iron Co., of Isabella, Tenn., and the Langeloth plant of the American Zinc & Chemical Co. He was forty-nine years old.

Alexander Del Mar, mining engineer, economist, and historian, died on July 1 at Little Falls, N. J. He was born in New York in 1836, a son of Mr. and Mrs. Jacques Del Mar. He studied at the Rev. Dr. Barry's Polytechnic School, Maurice's Military Academy, the Madrid School of Mines, and New York University. He was the author of the "History of the Precious Metals," and had been editor of various financial magazines. He took part in the International Monetary Congress in Russia in 1872 at the invitation of the Czar.

George A. St. Clair, of Duluth, died on June 19. He was one of the last of the pioneers of the Lake Superior iron region, and had been active in prospecting for iron ore, and in mining it, since boyhood. His early years were spent in the fields of northern Michigan, where he was engaged chiefly in the metropolitan district and about Marquette, and in the first days of the Mesabi range he went to Duluth, on his way to the Far West, where he proposed to settle. At Duluth he met John T. Jones, who was then developing the Biwabik mine, and was so enthusiastic over the possibilities of the Mesabi region that Mr. St. Clair decided to cast his lot in the new district. There he remained until his death, a loved and picturesque figure, a good citizen, and a compendium of information concerning the development of the entire Lake Superior country. Mr. St. Clair was by nature an optimist, and he kept his youthful spirit to the last; his vibrant hope, his unfailing courtesy, his delight in life remained with him, in spite of several years of serious ill-health. His optimistic spirit served him well in explorations for iron, and his success in that field was material. Of late years he had withdrawn from active mining and had contented himself with the care of his extensive iron land interests, in both Minnesota and Michigan. Some years ago, sensing the possibilities for magnetic concentration, he and associates purchased the land holdings of the original Mesaba Iron Company, which afterwards they turned over to Hayden, Stone & Co. and D. C. Jackling, who organized thereon the Mesabi Iron Company. This is the large enterprise at Babbitt, Minn. For many years he was closely associated with the firm of Pickands, Mather & Co., and had been an intimate friend of the founders of that great concern. Mr. St. Clair's span of life was coincident with the history of iron mining on Lake Superior. He saw and was a part of its marvelous growth. During his time the region grew from the obscurity of a wilderness to its present prominence, and in all this he had his full share. Such men as Whittelsey, Hill, Foster, Winchell, Pickands, Bacon, Mather, Sellwood, all now passed away, were his associates, and he was no less worthy of honored remembrance than the greatest of them.

DWIGHT E. WOODBRIDGE.

Recent Technical Publications

Reviews, Abstracts, and References

Interior of the Earth—Frank Wigglesworth Clarke has a two-page article on "The Internal Heat of the Earth" in the *Scientific American* for June (New York; price 35c.), in which he reflects the consensus of opinion about the temperature, structure, and composition of the earth, for the benefit of laymen. Volcanoes and hot springs are surface phenomena, caused by heat in the outer crust, and the seat of their activity is not more than five or ten miles below the surface. The center of the earth is probably a mass consisting largely of iron-nickel, in metallic form and at a temperature below its melting point. Surrounding this is an envelope of igneous rocks more than 800 miles thick.

Testing Hoisting Rope — The U. S. Bureau of Standards has recently issued Technologic Paper No. 315, pp. 20, on "Nondestructive Testing of Wire Hoisting Rope by Magnetic Analysis," by R. L. Sanford. There is a close connection between the magnetic and mechanical properties of steel, but the relationships are so complex that much more study will be needed before the results of magnetic tests can be interpreted with a sufficient degree of certainty to warrant their use as a practical method for the routine inspection of wire rope. Copies of the bulletin are obtainable from the Superintendent of Documents, Washington, D. C., for 10c. each.

Potash—U. S. Geological Survey Bulletin 785-B, pp. 15, by Walter B. Lang, is a discussion of "Potash Investigations in 1924." Several wells drilled for petroleum in western Texas have proved the existence of potash brines at depth, but the wells begun with the primary intention of exploring for potash have failed to penetrate the salts. Nevertheless, they are thought to be present, doubtless in quantities sufficient to justify commercial development. Suggestions for drilling and mining are given in this bulletin, as well as brief mention of potash occurrences in Grant County, Utah. Copies of the bulletin may be obtained on request to the U. S. Geological Survey, Washington, D. C.

Yellowstone Minerals — William F. Foshag is the author of "The Minerals of Obsidian Cliff, Yellowstone National Park, and Their Origin," a pamphlet (No. 2618) from the "Proceedings of the U. S. National Museum." It contains 18 pages of text and several plates.

Slag—Two plants of the Woodstock Slag Corporation, at Woodward and East Birmingham, Ala., respectively, are described in a four-page article in *Rock Products* for June 26, 1926. Crushing and loading operations are covered.

Prospecting — Geophysical methods of prospecting are discussed by Dr. Reich, Berlin, Germany, in an eight-page article entitled "Der gegenwärtige Stand und die Entwicklungsaussichten der geophysikalischen Untergrundsforschung," in *Metall und Erz* for June 1. Karl Sundberg contributes 10 pages on "Die schwedischen elektrischen Schürfmethoden," in the same issue. Two shorter articles on related subjects are also contained.

Statistics—Monthly metal and mineral statistics for the second half of 1925, for the British Empire and for foreign countries, are contained in the "Bulletin of the Imperial Institute," Vol. 24, No. 1, issued in June, 1926.

Gold—The report of the Transvaal Chamber of Mines containing the monthly analysis (for April, 1926) of gold production in the Transvaal has been received.

Zinc—The proceedings of the eighth annual meeting of the American Zinc Institute are contained in the May-June issue of "*Zn*," the official bulletin of the American Zinc Institute.

Petroleum—Bulletin 768 of the U. S. Geological Survey is entitled "Geology and Oil Resources of the Puente Hills Region, Southern California," by Walter A. English. A section written by Paul W. Prutzman is devoted to a discussion of the chemical character of the oil. The bulletin contains 110 pages and 14 plates.

Alaska Geology—"The Mesozoic Stratigraphy of Alaska" is the title of Bulletin 776 of the U. S. Geological Survey, by George C. Martin. It contains 493 pages.

Mineral Resources — Four advance chapters of "Mineral Resources of the United States, 1924," have been received from the Department of Commerce. They are: "Rare Metals—Cobalt, Molybdenum, Nickel, Tantalum, Titanium, Tungsten, Radium, Uranium, and Vanadium in 1924," by Frank L. Hess; "Copper in 1924," by Helena M. Meyer; "Gold, Silver, Copper, Lead, and Zinc in Montana in 1924," by C. N. Gerry; and "Talc and Soapstone in 1924," by L. M. Prindle and B. H. Stoddard.

Patents

Flotation—No. 1,587,789. June 8, 1926. H. W. Morse, Stanford University, Calif., assignor to Cie. du Boleo, San Francisco. A flotation agent consisting of an alkali metal xanthate and an alkali metal chloride.

No. 1,588,077. June 8, 1926. E. W. Wilkinson, San Francisco, and J. W. Littleford, Alameda, Calif., assignors to Minerals Separation North American Corporation, New York City. Design of a flotation cell using mechanical agitation.

Copper Precipitation—No. 1,586,035. May 25, 1926. F. F. Frick and C. E. Carstens, Anaconda, Mont., assignors to Anaconda Copper Mining Co., Anaconda. Waste solutions containing copper are treated with a basic material for precipitating the copper, the resultant sludge being leached with acid, and the copper content of the acid solution then being precipitated by electrolysis.

Hydrometallurgy—No. 1,588,679. June 15, 1926. E. W. Hale, Cleveland, and C. G. Fink, New York, assignors of one-half to The Dorr Co., New York City. A process of leaching and electrolytic precipitation for extracting metals from their ores which includes the formation of a metallic halogen compound and the subsequent replacement of the halogen by another halogen.

No. 1,588,806. June 15, 1926. R. D. Pike, San Mateo, Calif., and G. H. West, Albany, Calif. West assignor to Pike. A process of extracting metals from their ores which comprises, first, digesting the ore with solutions containing an excess of ferric iron to dissolve all of the metals that are soluble in ferric iron solutions. Sulphide of iron is then added to reduce all excess ferric iron to the ferrous condition and to reprecipitate certain metals at temperatures in excess of atmospheric boiling. The precipitate in which the iron content has been reduced is then separated. A flow sheet and further details of the process are given in the patent.

Flotation Agent—No. 1,590,196. June 29, 1926. Albert L. Clees, New York, assignor to Combustion Utilities Corporation, New York.

Filter—No. 1,590,233. June 29, 1926. Frederick F. Frick, Anaconda, Mont. A filter frame comprising a peripheral wall about a filter chamber formed by filter plates placed against the opposite faces of the frame.

Rock Drill—No. 1,590,261. June 29, 1926. William A. Smith, Athens, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. A valve.

Rock Drill—No. 1,590,268. June 29, 1926. Grover G. Tuttle, Phillipsburg, N. J., assignor to Ingersoll-Rand Co., Jersey City, N. J. A handle.

Rock Drill—No. 1,590,239. June 29, 1926. George H. Gilman, Belmont, Mass. A means of rock drill support.

No. 1,590,243. June 29, 1926. George W. Hulshizer, Stewartsville, N. J., assignor to Ingersoll-Rand Co., Jersey City, N. J. A means of controlling the air feed.

Mine Car—No. 1,590,255. June 29, 1926. Hugh W. Sanford, Knoxville, Tenn. A car of special design.

Rock Drills — Nos. 1,590,222 and 1,590,223. June 29, 1926. Lewis C. Bayles and Fred M. Slater, Easton, Pa., assignors to Ingersoll-Rand Co., Jersey City. A lug chuck for fluid actuated rock drills of the hammer type.

Blasting—No. 1,590,364. June 29, 1926. Harry L. Grant, Tamaqua, Pa., assignor to Atlas Powder Co., Wilmington, Del. An electric blasting cap.

Core Drill—No. 1,590,378. June 29, 1926. George Kammerer, Whittier, Calif., and Frank Hill, Los Angeles, assignors to Spengler Core Drilling Co., Los Angeles. A rotary core drill.

Filter—No. 1,590,401. June 29, 1926. Arthur Wright, Upper Montclair, N. J., and Frank W. Young, Corona, N. J. A rotary filter comprising a drum with a plurality of filtering compartments.

Plumb Bob—No. 1,590,410. June 29, 1926. Frank J. Bernard, Portland, Ore.

New Machinery and Inventions

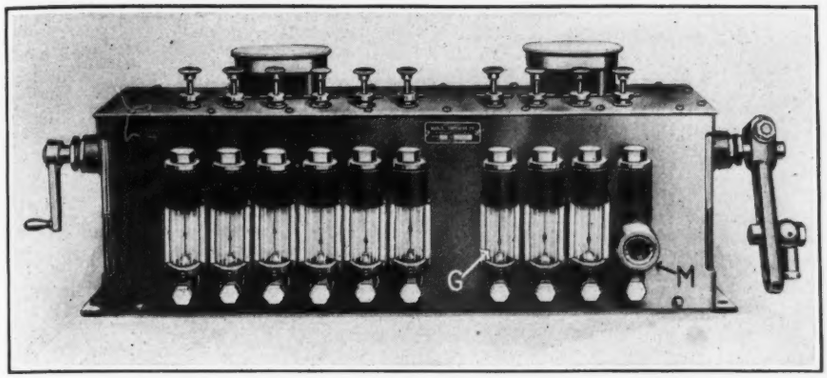


Fig. 1—Two-compartment lubricator having six engine and four air compressor feeds

A New Force-Feed Lubricator for Diesel Engines

The Manzel Brothers Co., Buffalo, N. Y., has recently extended its line of force-feed lubricators with the addition of Model 77, shown in the illustration, which has been designed especially for Diesel-engine lubrication. This new lubricator is built on the unit principle, a number of individual pumping units being placed in a central tank or reservoir, with one complete unit for each point to be lubricated. Each unit consists of a single plunger pump *A* (see Fig. 2) which is operated through a cam lever *B* by the cam *C* on the hexagonal drive shaft *D*, the shaft *D* in turn being driven by ratchet or other movement from some moving part of the engine. As will be seen by a study of Fig. 2, no intake valve is used, the plunger itself opening and closing the intake port.

In operation, the upward stroke of the plunger causes oil to be drawn through the strainer *E* into the small pocket directly below the plunger; on the return of the plunger the oil is forced out through the valve *F* and the sight glass *G*, which is filled with glycerin to the oil feed line *H*. A wire in the center of the sight glass guides the drops of oil and prevents them from touching the sides of the glass.

The feed of each pumping unit is adjusted independently and may be set to supply particles of a drop per stroke or increased to a maximum of five drops per stroke. The regulation of the feed is accomplished by raising or lowering the position of the cam lever *B* on the regulating screw *J*. This is done by turning the feed regulator *K* on the top of the oiler. This regulation may be made while the pump is in operation. The timing of the oil delivery to the cylinders is effected by setting the driving cams *C* at the proper position on the shaft *D*.

An individual hand pump is provided for each pumping unit, enabling the operator to flush any cylinder at will. In addition certain models are fitted with a hand crank on the drive shaft by means of which all pumping units may be operated simultaneously by hand. Tubular sight feed glasses *G* are used for pressures up to 400 lb., but for higher pressures the bull's-eye sight feed *M*, shown in Fig. 1, is furnished, it being designed for pressures up to 1,500 lb.

The lubricator shown in Fig. 1 is the two-compartment model having six feeds for the engine cylinders and four feeds for the air compressor.

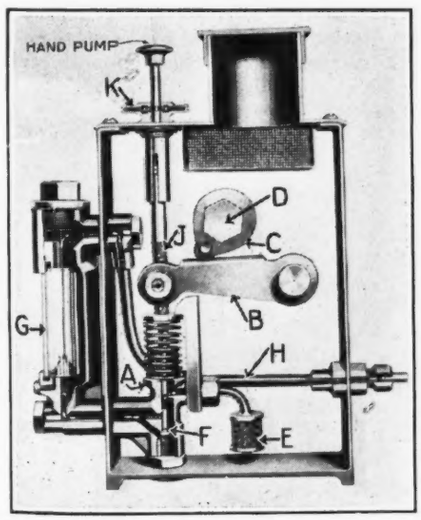


Fig. 2—Details of lubricator

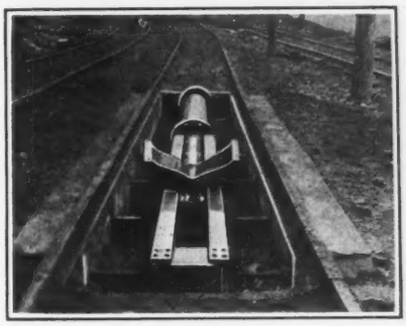
Feeds Heavy Trips with Ease

Cars may be fed to dumps that work intermittently by either electrically driven chains or by plungers or pistons working within cylinders. A new device of the latter type recently was placed on the market by the Car-Dumper & Equipment Co., of Chicago, Ill. This feeder is built and shipped as a unit that can be electrically welded or otherwise permanently fastened into a section of the track. The feeder shown in the accompanying illustration is in daily use at a mine in Pennsylvania, handling trips of as many as 100 cars at a time and feeding them to the dump at the rate of 10 to 11 per minute.

By a special construction of the carriage or cross-head embodying a fork that engages the car axles close beside the bearings, the bending stress imposed on these members is negligible. This permits the handling of heavy trips with the same action as is afforded by a double chain feeder, so far as engagement with the car is concerned.

In this feeder the main pushing cylinder works in one direction. The feeder plunger itself is hollow and acts as the return cylinder. This device operates under power in both directions, yet a minimum quantity of air is consumed in returning the device to the starting position. This represents a decided economy over the older types of air-actuated feeders. Another advantage claimed for this feeder is the fact that no finished parts are exposed at any time during the operation of the cylinder.

Naturally a device of this kind cannot compete with an electric feeder which affords continuous movement of the trip. Where intermittent movement only is desired, however, as in feeding cars to a rotary or crossover dump or to hoisting cages, this device answers the purpose excellently. Several installations have been made during the past year and all are reported as giving entire satisfaction.



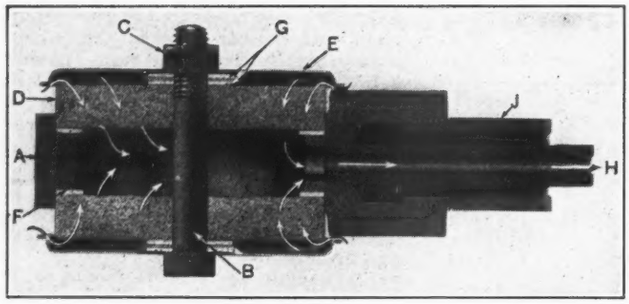
Pneumatic feeder in place

This Filter for Gas Analysis

Gas filtration is unquestionably the most important problem in connection with flue-gas analysis. The standard Pyro-porus filter, made by the Uehling Instrument Co., Paterson, N. J., is designed to exclude soot and fine ash from the sampling line in ordinary boiler practice. This filter is placed on the end of the gas sampling line within the boiler or flue, and as the hot gases enter it the soot and ash deposit on the outer surfaces of the porous refractory disks. Such deposit, being in itself very porous, does not interfere with gas flow; hence the disks require no cleaning or replacement for years.

For certain special applications, however, the standard filter is unsuitable, because of the impingement of incandescent particles of ash against the disks, which action seals the pores by causing a slag film to form over the surface of the disks, shutting off the gas flow. This is likely to happen in cement kilns and in certain metallurgical processes. It can also happen when burning fine coke braise on chain-grate stokers or powdered fuel by air blast. In the latter cases the particles of ash may be in a molten condition when they strike the filter, even though the filter is located in a position in the last pass where the flue-gas temperature is not over 400 or 500 deg. F.

This slagging action is completely



Sectional view of special filter with protecting shields

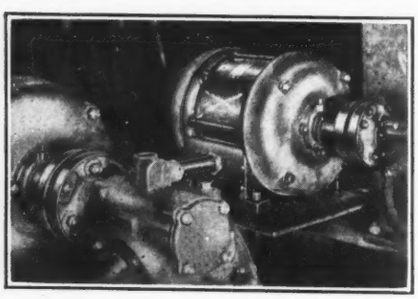
prevented and the filtering disks are protected indefinitely against sealing up by means of metal shields which are now applied to a new special Pyroporus filter. The accompanying cut shows a sectional view of the new filter, arrows indicating the gas flow through the porous disks *D*. The shields which protect the porous disks against direct impingement of molten particles are marked *E*. The filtering disks and shields are held together by bolt *B* and nut *C*, tight joints being secured by asbestos gaskets *G* and *F*. The weight of the filter casting *A* is supported in the boiler setting by pipe *J*, the gas being conducted away at high velocity by the smaller pipe *H*.

This filter is guaranteed to work effectively under any conditions between 200 and 1,400 deg. F. For higher temperatures, other features are necessary.

Metal-to-Metal Bearing Surfaces Avoided in New Coupling

A flexible shaft coupling, known under the name of "Flexoid," has been placed on the market by the Smith Power Transmission Co., 1218 Ontario St., Cleveland, Ohio. The new coupling, an application of which is shown in the accompanying illustration, consists of two cast-iron flanges coupled together with one or more flexible fabric disks in such a manner that there are no metal-to-metal bearing surfaces.

A joint of high strength and flexibility is claimed for this coupling. It is designed to permit a 6-deg. misalignment of the shafts without chatter. It requires no lubrication. The fabric is specially treated, and is impervious to oil and water. It also insures complete electrical insulation of the sections of the shaft. These couplings are made in eight sizes with capacities from 2 to 100 hp. at 1,000 r.p.m. They can be used efficiently on reversing drives, and are claimed to absorb shocks.



A new flexible shaft coupling

Switchboards Automatically Control Substation

In the accompanying illustrations may be seen the two switchboards constituting the new Cutler-Hammer automatic substation controller. This apparatus has been so designed that it starts the motor-generator set and automatically provides maximum protection without the expense of an attendant.

This controller is composed of two switchboards, one for the high- and the other for the low-tension current. These boards are interlocked both mechanically and electrically. The low-tension board is really the "master mind" of the control apparatus. It is this board which ferrets out the troubles and guards the motors, generators, machinery and control equipment from damage. It provides automatic starting, stopping and protection to all the equipment.

The apparatus can be made to start by means of a time clock or a push button which may be located at some remote point. After it is started by either of these methods the low-tension board takes full control, responding immediately to all emergencies as well as to normal conditions.

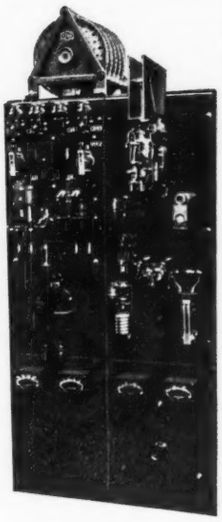
The following controls are provided in the construction of this low-tension board: Automatic starting from a push-button station; alternating-current, low-voltage release; automatic restart after return of alternating current; dead-phase, reverse-phase, phase-failure and field-failure protection; alternating-current overload protection by means of an instantaneous trip and also by an inverse time limit; thermal protection of the transformers; automatic opening and closing control of the direct-current circuits; direct-current overload protection by time limit and also instantaneously; direct-current, low-voltage and reverse-current protection. The board also contains an alternating-current line voltmeter, direct-current ammeters for synchronous motor field, direct-current line voltmeter and a line ammeter.

The high-tension board carries all of the high-tension switching equipment. It is interconnected with the low-tension board, and functions in combination with it. This board also contains a potential transformer, providing dead-phase protection and in addition furnishes low voltage for the alternating-current line voltmeter. High-tension fuses protect this transformer. This board also carries current transformers for use with the overload relays and the alternating-current ammeter. It has also oil-immersed switching equipment consisting of: A 3-pole manually operated oil circuit breaker, arranged for bell-crank operation from the front of the low-tension board; a 5-pole, oil-immersed, magnetic contactor used in starting, which connects the auto-transformer to the line, and the motor starter to the auto-transformer low-voltage tap, during the acceleration period; one 3-pole oil-immersed magnetic contactor used in running.

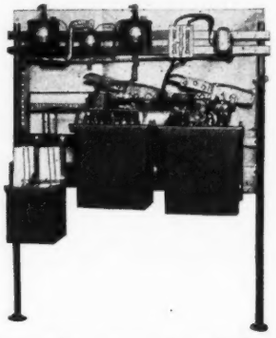
In order to prevent short circuiting the auto-transformer this contactor is mechanically interlocked with the starting contactor so that both cannot be closed at the same time. The transfer from the starting to the running contactors is accomplished by the supervisory relays on the low-tension panel. In the design of these switchboards, particular attention has been paid to accessibility for inspection and maintenance.

The Master Mind

This is a front view of the direct-current switchboard. It is interlocked both electrically and mechanically with the alternating-current board, the two forming the complete control. Most of the real control apparatus is, however, mounted on this board.



When the control circuit is closed either by push button or time clock, the synchronous motor comes up to speed and the direct-current circuit breaker is closed, connecting the load to the generator. If any trouble exists on either the direct- or alternating-current sides of the set which may damage the apparatus, or if such trouble should occur during operation, the set will automatically shut down until this difficulty is rectified. It will then resume operation automatically.



Alternating current switchboard

The Market Report

Spirited Metal Buying at Higher Prices

Both London and Domestic Markets Show Marked Advance in Copper, Tin, Lead, and Zinc—American Consumers Need Metals Badly

New York, July 14, 1926—It appears that consumers of the non-ferrous metals have finally come to the conclusion that the much-talked-of depression during the second half of the year is not to materialize. This is one reason for the substantial improvement in all of the markets during the last week. Contributing factors are the improved statistical position of zinc and copper, the dearth of copper and lead for July shipment, and speculative holding of lead in the London market. However, the real need of domestic manufacturers for metals consequent upon the long period of hand-to-mouth buying is sufficient to strengthen the markets. Share prices on the Stock Exchange are climbing today, and this engenders optimism among metal producers.

Daily Prices of Metals

July	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
8	13.675@13.75	60 25	62 375	8.25	8 10@8.15	7.275@7.325
9	13.775	60 25	62 50	8.275	8.125	7.30@7.40
10	13 775	60.25	62 50	8.275	8 125	7.30@7.40
12	13.75@13.875	60 25	62 25	8.25@8.30	8 15	7 50
13	13.875@13.90	60 75	62 625	8.40@8.45	8.25@8.35	7.50@7.55
14	13.95@14.00	61 25	63.25	8.50	8 35	7.55
Av.	13.823	60 500	62.583	8 333	8.196	7.429

The prices correspond to the following quotations for copper delivered: July 8th, 13.925@14.00; July 9th and 10th, 14.025; July 12th, 14.00@14.125c.; July 13th, 14.125@14.15c.; July 14, 14.20@14.25c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

July	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
8	57¼	58	65	277½	277½	30⅞	30⅞	33 15/16	33 15/16
9	57⅜	58¼	65	277½	277½	30 13/16	30 13/16	34 1/16	34 1/16
12	57⅞	58⅝	65½	277¼	277	31 3/16	31 3/16	34 5/16	34 7/16
13	57⅞	58⅝	65½	278¼	277⅞	31 7/16	31 7/16	34⅜	34⅜
14	58¼	59	66	280½	280	31 11/16	31 11/16	34⅜	34½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

July	Sterling Exchange "Checks"	Silver		Gold London	July	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
8	4.85¾	65⅝	30 3/16	84s11½d	12	4.85⅝	65⅛	30	84s11½d
9	4.85⅝	65½	30⅛	84s11½d	13	4.85¼	65¼	30	84s10½d
10	4.85⅝	65⅜	30 1/16	.....	14	4.85¼	65½	30⅛	84s10¾d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Copper Close to 14¼c. Delivered

Copper prices have advanced steadily during the week, with practically no metal obtainable at less than 14.25c. delivered in the Connecticut valleys late today. The volume of sales has been unusually large, exceeding any like period since the record week of May 12. Five leading agencies divided the business almost equally.

Considerable tightness exists as to the July position, and it is possible that buyers who require early shipment will find it necessary to pay a premium. One of the refineries near New York finds it necessary to curtail output because of the condition of one of its refining furnaces, and this will tend to emphasize the shortage of actual metal. The statistics for June issued on July 13 show a reduction in combined stocks of blister and refined amounting to 14,254 tons. Deliveries to domestic consumers in June (78,206 tons) were the largest since last March. Shipments abroad, on the other hand, declined in June. Sales in the Middle West were made at 14⅛c. last Friday and at 14¼c. on Monday and yesterday. The volume, however, was not large.

Zinc Stocks Decline

Zinc has been active, with a stiffening of the price each day. Galvanizers and brass makers both are in the market, principally for July and August delivery. A decline in stocks amounting to 4,174 tons is revealed by the statistics for June, and a further reduction is likely as a consequence of curtailment in the Joplin district in July. The following figures have just been issued by the American Zinc Institute in tons of 2,000 lb.:

Stock, June 1	29,934
Produced	48,226
Total	78,160
Shipped	52,400
Stock, June 30	25,760
Shipped from plant for export	6,239
Stored for customers	1,148
Retorts operating June 30	76,912

A. S. & R. Lead Price Now 8.50c.

With demand for lead unusually insistent, and with the London market showing substantial gains, the American Smelting & Refining Co. increased its official contract price from 8.25c. to 8.40c. on July 13. The outside market, however, kept ahead of the

official price, and with inquiry unabated an additional increase of $2 per ton, to 8.50c., was made this morning. In the Middle West the leading producer maintained a base price of 8.10c. to its regular customers until yesterday, when 8.25c. became the ruling figure with 8.35c. asked today. Some business has been done at premium prices both in New York and in St. Louis, as indicated in our quotations. As usual on a rising market, the so-called blue-lead manufacturers predominate as buyers. In spite of large stocks in Britain, there is a slight backwardation in London, indicating that the metal is in strong hands.

Tin Also Advances

The tin situation is dominated by London. Consumers in the United States are not believed to be well supplied for future requirements, and there has been moderate buying in the domestic market, at advanced prices.

Foreign Exchange Erratic

Continental exchanges, except marks, sagged badly and then recovered somewhat during the week. Closing cable quotations on Tuesday, July 13, are as follows: francs, 2.57c.; lira, 3.43c.; and marks, 23.81c. Canadian dollars are at a premium of ⅛ per cent.

Silver Steady

During last week Indian bazaar rates for silver remained below the price level of the New York market, and quotations continued to sag. However, an improvement in the Indian position supported by orders for account of China and the Continent has advanced the market, and the tone is steady at the close.

Mexican Dollars (Old Mexican pesos): July 8th and 9th, 50¼c.; 10th, 50⅛c.; 12th, 49⅞c.; 13th, 50c.; 14th, 50¼c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—99 per cent grade, 27@28c. per lb.; 98@99 per cent, 27c.; 94@99 per cent, 26c. The Aluminum Company of America has cut its price of 99 per cent by 1c. and has injected a new grade, 94@99 per cent. London, 98 per cent, £116@£118 per long ton.

Antimony—Per pound, duty paid, New York: Chinese brands, spot, 13.75@14c. August arrival, 12.75@13.50c. Cookson's "C" grade, spot, 21c. Market narrow but firm.

Bismuth—Per pound. New York, in ton lots, $2.70@$2.75. London, 10s.

Cadmium—Per pound, New York, 60c. London, 1s. 10½d. for American metal; 1s. 9d. for Australian metal.

Iridium—Per ounce, $125@$135 for 98@99 per cent. Nominal. London, £63@£65 in iridio-platinum.

Nickel—Per pound, ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton according to quantity.

Osmium—Per ounce, $65@$75; London, £17@£20.

Palladium—Per ounce, $70@$72. Pure metal as a constituent of crude platinum, $60@$65 per oz. London, £12@£15, nominal.

Platinum — Refined, per ounce, officially quoted, $114 on July 8th to 10th; $115 on July 12th to 14th. Sales also at $111@$113. Pure metal as a constituent of crude platinum, $109. Market has stiffened in the last few weeks; better buying.

London, £23½ per ounce for refined, and £20½@£21 for crude. Demand limited.

Quicksilver—Per 75-lb. flask, $90@$90.50. Market is firm for futures; weaker for spot. San Francisco wires, $90. London, £15.

Ruthenium—Per ounce, $60@$70, nominal; London, £12@£15.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Radium, Rhodium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium** are unchanged from the issue of July 3.

Metallic Ores

Tungsten Ore—Per unit of WO_3, N.Y.: Wolframite, $10.50@$10.60; Western scheelite, $10.75@$10.85.

Vanadium Ore—Containing 4 to 8 per cent V_2O_5, 30@35c. per pound of V_2O_5 f.o.b. Montrose, Colo.

Foreign concentrate (lead vanadate) 12 to 18 per cent V_2O_5, 60@65c. per pound V_2O_5, duty paid, seaboard.

Chrome Ore, Iron Ore, Manganese Ore, Molybdenum, Tantalum, and Uranium are unchanged from quotations in the July 3 issue.

Zinc Blende Price Advanced—Lead Ore Unchanged

Joplin, Mo., July 10, 1926

Zinc Blende	Ton
High	$53.60
Premium blende, basis 60 per cent zinc	$51.00@52.00
Prime Western, basis 60 per cent zinc	50.00
Fines and slimes, 60 per cent zinc	48.00@45.00
Average settling price, all zinc	47.66
Galena	
Basis 80 per cent lead	$100.00
High	102.30
Average settling price, all lead	100.00

Shipments for the week: Blende, 10,108; lead, 2,766 tons. Value, all ores the week $758,380.

Sellers were not a little surprised when buyers voluntarily advanced offerings for blende $2 per ton. Answering the query of a seller as to the cause, one buyer replied very frankly: "So you will produce more ore." Production this week dropped to 8,600 tons, owing to the general closing down of mines, giving owners and miners a holiday extension. It is estimated that only sixty mills, or approximately one-third, were in operation this week.

It is reported that one carload of lead was marketed at a basis price of $101, but buyers quote the market very steady and comparatively easy on $100 basis.

Platteville, Wis., July 10, 1926

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$50.75
Lead Ore	
Lead, basis 80 per cent lead	$100.00

Shipments for the week: Blende, 881 tons; lead, none. Shipments for the year: Blende, 28,873; lead, 752 tons Shipments for the week to separating plants, 1,799 tons blande.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the July 3 issue.

Mineral Products

Arsenious Oxide (White arsenic)—3½c. per lb. Occasional carlots sold. London, £14 per long ton.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate (Salt Cake), and Zinc Oxide are unchanged from prices in the July 3 issue.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $88@$90 per gross ton, furnace; prompt and future.

Ferrosilicon — Per gross ton, f.o.b. works: 50 per cent, $85 delivered in carload lots; 75 per cent, $145; 14-16 per cent, $45.

Ferrotungsten—Per pound contained W, f.o.b. works according to grade, $1@$1.05.

Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrotitanium, Ferrouranium, Ferrovanadium, and Spiegeleisen are unchanged from prices in the July 3 issue.

Metal Products

Rolled Copper—Per pound, sheets, 22½c.; wire, base price, 16c.

Zinc Sheets—Per pound, f.o.b. works, 11.50c.

Lead Sheets, Nickel Silver, and Yellow Metal are unchanged from prices in the July 3 issue.

Refractories

Chrome Brick, Firebrick, Magnesite Brick, Silica Brick, and Zirkite are unchanged from prices in the July 3 issue.

Steel Firm—Pig Iron Dull—Furnace Coke Slightly Higher

Pittsburgh, July 13, 1926

The general tone of the market as to steel prices is firm, the notable points being the recent stiffening in bars, shapes, and plates from their average of the last six months, and the steadiness of sheets following their long decline.

Pig Iron—The Valley market continues dull, while there is a fair turnover in most other districts, following the heavy buying of June. Bessemer, $19; basic, $17.50; foundry, $17.75, f.o.b. Valley furnaces.

Connellsville Coke.—Pre-holiday buying cleaned up floating supplies of furnace coke, but offerings are again appearing. Spot furnace, $2.85@$3; spot foundry, $4@$4.50.

Copper Refinery in Great Britain Proposed

In the July issue of "Anglo-American Trade," published by the American Chamber of Commerce in London, is an article by J. J. Young in which a proposal is made to erect an electrolytic copper refinery in Great Britain. After reviewing briefly the world situation in copper the article says:

"Much time could be saved, the cost of transportation charges correspondingly reduced, and the interest tied up in the metal in transit before and after refinement greatly lessened, if the crude copper could be sent direct from the Chile and African mines to some refinery suitably located in Europe where the shipping, fuel, and other conditions were most advantageously available, and the transportation facilities were most favorable for reaching the whole European markets.

"There are practically no such favorably located works of this nature in Europe except in a small way, and a suggestion appeared in a prominent American trade journal a few weeks ago by a Paris correspondent urging the establishment of a copper refinery in France, which uses about 125,000 tons of the metal annually. It stated that coal could be obtained from England, labor was cheap, and the natural prejudice against an American export copper association controlling the European market could be thus overcome, if the metal could be assured in sufficient quantities to keep the plant going.

"But a more available location for such an establishment would be at some convenient port in England, near the coalfields, such as Swansea, where the copper-refining industry was born and the people are experienced in treating all kinds of non-ferrous ores and metals for centuries past. Here the shipping and transportation facilities are all that can be desired, with a home market that uses over 100,000 tons annually, while the proposed great national system of super-electricity will insure a great demand for copper for many years to come.

"Moreover, the African copper deposits that are known to be the largest in the world, and their ores of the richest character, are largely owned by British capital in connection with Belgium-Congo interests, where labor is very cheap. These interests will naturally favor a British industry of this nature, as will the English manufacturers who use the metal.

"A plant of moderate size with a 100,000-ton annual capacity output, costing say £500,000, would require at least about £2,000,000 more for carrying the metal through the treatment process, paying for stocks, and giving credit to customers. But American producers could supply these stocks on credit and greatly advance their own foreign trading interests by co-operating in the conduct of such a refinery located in England, with their capital, management, and the supply of the metal required.

"Owing to the abnormally low price of copper in America, which adversely affects the old line mines in Michigan and Arizona, the Congressional representatives of those states are advocating the establishment of a six cents a pound tariff upon all copper imported into the United States, which may soon become law.

"If large American producers will ship their foreign produced crude metal to a British refinery for the European market this market can absorb the whole of the foreign product, and it would not compete against the United States copper industry in any way, whether a tariff is imposed upon foreign importations or not, as they now amount to a little over 300,000 tons per annum, and Europe can absorb nearly double that amount of the metal, even under present limited capacity of purchasing power.

"Great Britain is buying about 100,000 tons of copper annually from the United States, of which less than one-fifth is in the manufactured state and over four-fifths is as raw material to be made up by British manufacturers. The proposed refinery here would only put the crude copper into a condition for manufacturing purposes, and in fact be only one step in advance as to its condition from the 'blister' state as it comes from the smelters, and thus be practically in the 'raw' state for the manufacturers to obtain here. The refinery therefore would not be in any way competitive so far as American manufacturers of copper would be concerned, except to the small amount of £1,000,000 or so involved per annum.

"The saving to American producers of the time, freight charges and interest on the capital tied up in the metal would offset the small profit derived by them in refining the metal intended for European markets in the United States, with the consequent loss in time and delays in realizing payment for their copper.

"This whole matter has been deemed so important by a group of persons and interests in London, that preliminary negotiations are now in progress with important American and British interests towards carrying out these suggestions, and any further particulars regarding it may be had by communicating with the American Chamber of Commerce in London."

"Crude" Platinum

A question recently has arisen regarding the interpretation of the word "crude" as applied to *Engineering and Mining Journal* quotations for platinum. The mineral as shipped after washing to the refinery from the mine frequently contains allied metals of the platinum group and other constituents to the total amount of about 15 per cent, leaving the content of fine or pure platinum only 85 per cent. Our quotation for "crude" applies to the price paid per ounce of pure platinum contained in the "crude" mineral or mine product and not to the crude mineral itself. Obviously a quotation based on the latter interpretation would be inaccurate for the reason that the analysis of crude mineral may vary over a wide range.

This situation is thoroughly understood in the United States and Europe—in fact in all consuming markets—and no misapprehension exists as to the significance of the quotation. In some of the producing countries the matter is not clear, and for that reason our quotation hereafter will read "pure metal as a constituent of crude platinum."

Company Reports

Burma Mines' Output Exceeded 1,000 Tons Daily in First Quarter

Production of ore by the Burma Corporation from its mines in Upper Burma totaled 97,473 tons during the first quarter of 1926, according to the report just issued. Surplus revenue over operating expenditure was £346,282.

		Average Grade—			
	Tons	Silver, Ounces	Lead, Per Cent	Zinc, Per Cent	Copper, Per Cent
Concentrating ore to mill	77,953	18.31	20.71	12.96	0.80
High-grade ore to smelter	6,784	33.01	37.20	20.07	0.57
Total lead ore	84,737	19.49	22.03	13.53	0.78
Copper ore to smelter	12,054	20.24	12.63	7.28	7.97
Grand total	96,791	19.58	20.86	12.75	1.68

The tonnage extracted was equal to an output of 0.315 ton per man-shift employed underground.

Production figures follow: A total of 79,500 tons of ore was milled, averaging 18.2 oz. of silver, 20.6 per cent lead and 12.9 per cent zinc; 30,504 tons of lead concentrates was produced, averaging 39.4 oz. of silver, 46.5 per cent lead, and 14.6 per cent zinc; 10,950 tons of zinc concentrates was produced in the experimental plant, averaging 13.7 oz. of silver, 7.5 per cent lead and 45.1 per cent zinc; 35,255 tons of lead-bearing material, including 6,359 tons of high-grade ore, was smelted for a production of 14,540 tons of hard lead, assaying 92.2 oz. of silver per ton. The refinery produced 14,125 tons of refined lead and 1,473,663 oz. of refined silver. Also, 2,571 tons of copper matte, assaying 57.3 oz. silver, 22.9 per cent lead, and 42.9 per cent copper, was produced and shipped from the treatment of accumulated smelter by-products, and 11,059 tons of copper ore. Also 170 tons of antimonial lead was produced.

Estimated Revenue and Expenditure

Estimated gross revenue	£822,877
Estimated operating expenditure	476,595
Estimated surplus over working expenditure	£346,288
Estimated income tax and super tax	£58,147
Estimated depreciation on machinery and plant	55,552

Capital expenditure = £52,454.

The circular shaft had been sunk to a depth of 892 ft. by the end of March, being within 36 ft. of the point at which No. 8 level connection will be made. Satisfactory progress was made with the erection of the winding engines and equipment for the circular shaft.

Mining Stocks—Week Ended July 10, 1926

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	47⅜	46⅝	47⅛	Jy.17, Au.23	Q 0.75
Arcadian Consol.	Boston	*70	*65	*70		
Ariz. Com'l	Boston	11½	10⅞	11½	Jy. 16, Jy. 30	0.50
Calaveras	N. Y. Curb	....	....	1⅜		
Calumet & Arizona	New York	67½	66½	67	Jn. 4, Jn. 21	Q 1.50
Calumet & Hecla	Boston	14⅜	14⅛	14⅜	Jn. 1, Jn. 15	Q 0.50
Cerro de Pasco	New York	65⅞	64½	65⅞	Jy. 15, Au. 2, Q	1.00
Chile Copper	New York	33⅛	32½	33⅛	Jn. 2, Jn. 28, Q	0.62½
Chino	New York	....	....	22⅜	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	3⅜	3⅜	3⅜		
Copper Range	Boston	14⅜	14⅛	14⅜	May, 1925	1.00
Crystal Copper	Boston Curb	*40	*36	*37		
East Butte	Boston	3⅛	2⅛	3	Dec., 1919	0.50
First National	Boston Curb	....	....	*16	Feb., 1919	0.15
Franklin	Boston	*40	*40	*40		
Granby Consol.	New York	21⅛	20⅛	21⅛	May, 1919	1.25
Greene-Cananea	New York	16⅜	15⅞	16⅛	Nov., 1920	0.50
Hancock	Boston	*50	*50	*50		
Howe Sound	New York	38⅜	37⅜	38⅜	Ap.1, Ap.15	0.75
Inspiration Consl.	New York	23⅞	23	23	Jn.7, Jy.6, Q	0.50
Iron Cap	Boston Curb	3⅜	3⅜	3⅜	Jn. 1, Jn. 15	0.50
Isle Royale	Boston	10	10	10	Jn. 1, Jn. 15	0.50
Jerome Verde Dev.	N. Y. Curb	*58	*50	*58		
Kennecott	New York	55	53⅜	54⅛	Jn. 4, July 1	Q 1.00
Lake Copper	Boston	*75	*75	*75	June, 1925	0.50
Magma Copper	New York	38⅛	38	38	Jn.30, July.15,	Q 0.75
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Mass Consolidated	Boston	*25	*25	*25	Nov., 1917	1.00
Miami Copper	New York	14⅛	13⅛	14⅛	Aug.2, Aug.16	Q 0.25
Mohawk	Boston	34⅛	33⅜	33⅜	My.1, Je.1	Q 1.00
Mother Lode Cos.	New York	5⅞	5⅜	5⅜	Jn. 15, Jn. 30	0.37½
Nevada Consol.	New York	13⅜	13⅛	13⅜	Jn. 15, Jn. 30	Q 0.25
New Cornelia	Boston	22	21	22	My.7, M.24	Q 0.40
North Butte	Boston	2⅜	2⅛	2⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*61	*60	*60	No. 14, De. 2	0.05
Old Dominion	Boston	16⅞	15½	16	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†125	†122	....	Jun.22, July2	Q 1.50
Quincy	Boston	18	17⅞	17⅞	Mar., 1926	1.00
Ray Consolidated	New York	14	13⅞	14	Ap.20, Ap.30	0.25
Ray Hercules	N. Y. Curb	....	....	11⅞		
St. Mary's Min. Ld.	Boston	28	28	28	Ap.17, My.18	2.00
Seneca Copper	New York	....	....	5⅞		
Shannon	Boston	*35	*35	*35	Nov., 1917	0.25
Superior & Boston	Boston	*55	*55	*55		
Tenn. C. & C.	New York	11⅞	11⅜	11⅜	My. 29 Ju.15,	Q 0.25
United Verde Ex.	N. Y. Curb	28	27⅞	27⅞	Jy.17, Aug. 2,	0.75
Utah Copper	New York	....	....	100	Jn.15, Jn.31	Q 1.25
Utah Metal & T.	Boston	1⅜	1⅛	1⅛	Dec., 1917	0.30
Victoria	Boston	....	....	*41		
Walker Mining	Salt Lake	....	....	*20		
NICKEL-COPPER						
Internat. Nickel	New York	37⅞	36⅛	36⅜	Jn.30, Ju.15,	Q 0.62½
Internat. Nickel, pfd.	New York	37⅞	36⅛	36⅛	Ap.15, My.1,	Q 1.50
LEAD						
Gladstone M. M. Co.	Spokane	*31⅛	*29⅛	*29⅛	Jn. 10, July10	0.1½
National Lead	New York	159	157½	157½	Jn. 11, Jn. 30	Q 2.00
National Lead pfd.	New York	117⅞	117⅛	117⅛	My.21, Je.15	Q 1.75
St. Joseph Lead	New York	42	41⅛	41⅛	Jn.10, Jn.21	QX 0.75
ZINC						
Am. Z. L. & S.	New York	7⅛	7	7⅛	May., 1920	1.00
Am. Z. L. & S, pfd.	New York	33⅛	33	33⅛	Nov., 1920	1.50
Butte C. & Z.	New York	5	4⅞	4⅞	De.10, De.24	0.50
Butte & Superior	New York	10	9⅞	9⅞	Jn.15, Jn.30	Q 0.50
Callahan Zn-Ld.	New York	1⅛	1⅛	1⅛	Dec., 1920	0.50
Eagle Picher	Cincinnati	33⅛	29⅛	31	My. 15, Jn.1	0.40
Eagle Picher, pfd.	Cincinnati	....	....	110	Jn.30, Jy.15	Q 1.50
New Jersey Zn.	N. Y. Curb	....	....	208	Jn.9, Jy.10	Q 2.00
United Zinc	N. Y. Curb	....	....	*70		
Yellow Pine	Los Angeles	*25	*25	*25	De.8, De.18	Q 0.04
GOLD						
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Argonaut	Toronto	*21	*18½	*18½		
Barry-Hollinger	Toronto	*48	*47	*47		
Carson Hill	Boston	*30	*30	*30		
Consol. W. Dome L.	Toronto	*15½	*15	*15½		
Cresson Consol. G.	N. Y. Curb	2⅞	2½	2½	Mh.31, Ap.10	0.10
Crown Reserve	Toronto	*11⅛	*9½	*11	Jan., 1917	0.05
Dome Mines	New York	12⅜	11⅞	11⅞	Jn.30, July 20,	Q 0.50
Golden Center	N. Y. Curb	1⅞	1⅛	1⅛		
Golden Cycle	Colo. Springs	†1.50	†1.49	....	No.30, Dec.10	Q 0.03
Hollinger Consol.	Toronto	19.50	19.15	19.20	Jn.29, Jy.15	Q 0.10
Homestake Mining	New York	54½	54	54½	Jy.20, Jy.26	M 0.50
Kirkland Lake	Toronto	1.04	1.00	1.02		
Lake Shore	Toronto	11.40	11.20	11.38	Jn.1, Jn. 15	Q 0.10
McIntyre-Porcupine	New York	25	24⅞	25	My.1, Jn.1	0.25
Newray	Toronto	....	....	*33		
Noranda	N. Y. Curb	15⅜	15	15⅜		
Portland	Colo. Springs	†*48	†*46⅛	....	July6, July15	0.02
Rand Mines	New York	....	....	37⅛	Fe.16, Fe.26	1.52
Teck-Hughes	Toronto	3.87	3.70	3.86	Jy. 15, Au. 2	0.05
Tom Reed	Los Angeles	....	....	*60	Ma.10, Ma.20	0.02
Tough-Oakes	Toronto	*39½	*35	*38½		
United Eastern	N. Y. Curb	....	....	*30	July, 1924	0.05
Vipond Cons.	Toronto	1.73	1.70	1.71		
Wright-Hargreaves	Toronto	8.45	8.40	8.45	Jn.15, Jy.1	Q X 0.07½
Yukon-Alaska Trust	N. Y. Curb	....	....	21		
GOLD AND SILVER						
Carnegie Metals	Boston	14½	14½	14½		
Con. Cortez	N. Y. Curb	....	....	*6		
Con. Virginia	San Francisco	*6½	*6½	*6½		
Continental Mines	N. Y. Curb	....	....	*45		
Dolores Esperanza	N. Y. Curb	....	....	*39	July, 1923	0.05
Premier Gold	N. Y. Curb	2⅛	2	2	Jn.18, Jy.3	Q 0.08
Tonopah Belmont	N. Y. Curb	3¼	3⅛	3⅛	Se.15, Oc.1	0.05
Tonopah Extension	N. Y. Curb	....	....	*45	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	6⅛	6⅛	6⅛	Ap.7, Ap.21	Q 0.07½
Unity Gold	N. Y. Curb	....	....	*20		
West End Consol.	N. Y. Curb	....	....	*16	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	*30	*30	*30	June, 1918	0.02

Stock	Exch.	High	Low	Last		Last Div.
SILVER						
Alvarado	N. Y. Curb	....	....	1	Oct., 1920	0.50
Beaver Consol.	Toronto	*81	*77	*81	May. 1920	0.03
Castle-Trethewey	Toronto	1.53	1.44	1.53	....	....
Coniagas	Toronto	3.60	3.60	3.60	May, 1924	0.12½
Keeley	Toronto	1.65	1.42	1.60	Ma.1, Ma.15	X 0.12
Kerr Lake	N. Y. Curb	....	....	1	Ap.1, Ap.15	0.12½
La Rose	Toronto	*12½	*11½	*11½	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	....	....	*85	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav.	Toronto	*15	*14½	*15	Oct., 1920	0.03
Mining Corp. Can.	Toronto	3.48	3.40	3.45	Jy.1, Jy.15	0.12½
Nipissing	N. Y. Curb	5⅜	5⅛	5⅜	Jn.30, Jy.20	0.15
Temiskaming	Toronto	....	....	*11	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	....	....	8	Jn.18, Jy.5, Q	X 0.25
Alta Merger	Salt Lake	†*5½	†*2½	....	....	....
Bingham Mines	Boston	34	33⅞	34	Jn.19, Jn.30	Q 1.00
Cardiff M. & M.	Salt Lake	....	....	*50	De.16, No.18	0.10
Chief Consol.	Salt Lake	....	....	3.06	Jy.10, Au 10	Q 0.10
Emma Silver	Salt Lake	†*75	†*50	....	....	....
Erupcion	Boston Curb	....	....	1⅜	Jn.18, Jy.5,	QX 0.10
Federal M. & S.	New York	74	73½	73½	....	....
Federal M. & S., pfd.	New York	....	....	74½	My.25, Ju.15	Q 1.75
Hawthorne Mines	N. Y. Curb	*19	*17	*17	....	....
Hecla Mining	N. Y. Curb	17⅛	17⅛	17⅛	My.15, Je.15	Q 0.50
Iron King Mining	Salt Lake	....	....	*27	....	....
Keystone Mining	Salt Lake	....	....	*25	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*17	*17	*17	....	....
Mammoth Mining	Salt Lake	....	....	2.85	Mar.24, Apr. 1	0.10
Marsh Mines	Spokane	2⅛	2	2	Se.15, Oc.1	0.15
Park Utah	New York	6⅛	6⅛	6⅛	Jn.15, Jy.1	Q 0.15
Prince Cons.	Salt Lake	....	....	1⅜	....	....
Silver King Coal	Salt Lake	....	....	8.25	Jn. 21, July1,	Q 0.25
Silversmith	Spokane	*44½	*44½	*44½	Jn.30, Jy.10	Q 0.02
Tamarack-Custer	Spokane	*28	*27	*27	Sept., 1924	0.25
Tintic Standard	Salt Lake	....	....	12.75	Jn.16, Jn.26,	0.40
Utah-Apex	Boston	7⅞	7⅜	7⅜	Jy. 3, Jy.15	Q 0.25
Western Utah Copper	N. Y. Curb	....	....	*8	....	....
IRON						
Bethlehem Steel	New York	47½	42½	45⅜	July, 1924	1.25
Colorado Fuel & Iron	New York	46⅜	43½	44⅜	May, 1921	0.75
Gt. North'n Iron Ore	New York	21⅜	21	21⅛	De. 4, De. 28,	0.75
Inland Steel	New York	43	42	42½	My.10, Je.1	Q 0.75
Mesabi Iron	N. Y. Curb	....	....	1⅜	....	....
Replogle Steel	New York	10⅞	10½	10⅝	....	....
Republic I. & S.	New York	56⅜	55	55⅛	May, 1921	1.50
Republic I. & S. pfd.	New York	95⅛	94½	95⅛	Jn.15, July1,	Q 1.75
Sloss-Sheffield S. & I.	New York	139½	130	131⅞	Jn.10, Jn.21	Q 1.50
Sloss-Shef. S.&I. pfd.	New York	....	....	110	Jn.21, July.1,	Q 1.75
U. S. Steel	New York	144⅛	138½	140⅜	Jn.2, Jn.29	Q 1.75
U. S. Steel pfd.	New York	129½	129⅜	129⅜	My.4, My.29,	Q 1.75
Virginia I. C. & C.	New York	47	47	47	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York	72	72	72	Jn.1, July 2,	2.50
ALUMINUM						
Alum. Co. of Amer.	N.Y. Curb	Ind. 74	74	74	....	....
Alum. Co. of Amer pf.	N.Y. Curb	Ind.	....	99⅜	June 15, July1,	Q 0.01½
VANADIUM						
Vanadium Corp.	New York	37	35¾	36⅞	My.1, My.15,	Q 0.75
ASBESTOS						
Asbestos Corp., New	Montreal	19½	18	19	De.31, Ja.15	Q 1.50
Asbestos Corp., pfd.	Montreal	75	72	73	Jy.1, Jy.15,	Q 1.75
SULPHUR						
Freeport Texas	New York	34	32½	33⅛	Nov., 1919	1.00
Texas Gulf	New York	152⅞	150	152⅛	Jn.1, Jn. 15,	Q 2.50
DIAMONDS						
De Beers Consol.	New York	....	....	35⅛	Ju.16, Ju.17	1.70
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	5⅛	5	5⅛	....	....
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	54⅛	52⅞	54⅛	My.20, Je. 1,	Q 1.00
Amer. Metal pfd.	New York	117⅞	117	117	My.20, Je. 1	Q 1.75
Amer. Sm. & Ref.	New York	136⅛	130⅛	132	Jy.10, Au.2,	Q 1.75
Amer. Sm.&Ref.pfd.	New York	118	117¼	117⅜	Au.7, Se.1,	Q 1.75
Consol. M. & S.	N. Y. Curb	....	....	208	Jn.30, Jy.5	QX 3.75
Federated Metals	N. Y. Curb	....	....	12⅛	....	....
Newmont Mining	N. Y. Curb	62	60	60⅞	Mar.31, Apr.15,	0.60
Southwest Metals	N. Y. Curb	....	....	1	Jn.30, Jy.15	0.60
U. S. Sm. R. & M.	New York	41⅛	39⅛	39⅜	Jy. 7, Jy. 15,	Q 0.87½
U. S. Sm. R.&M.pfd.	New York	50	48⅛	48⅜	Jy. 7, Jy. 15,	Q 1.75

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED JUNE 29, 1926

Name	High	Low	Last	Last Divd. Date	Amount
Aramayo Mines (25 frs.)	80/7½	78/1½	78/9	May. 1926	5 p.c.†
British Platinum (£1)	6/6	5/7½	6/—	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	16/—	15/4½	15/7½	Aug. 1926	7 annas*
Bwana M'Kubwa (5s)	7/10½	7/4½	7/10½		
Camp Bird (£1)	5/3	4/9	4/10½		
El Oro (£1)	6/4½	5/9	6/1½	Nov. 1924	2½ p.c.*
Esperanza (10s)	1/1½	1/—	1/—		
Frontino & Bolivia (£1)	8/9	7/6	8/9	July 1926	2½ p.c.
Mexican Corpn. (£1)	16/6	15/7½	16/3	Dec. 1925	12½ p.c.*
Mexico Mines of El Oro (£1)	29/4½	27/6	27/6	June 1926	7½ p.c.*
Oroville Dredging (£1)	3/10½	3/9	3/9	Dec. 1923	3½ p.c.
Ouro Preto (£1)	2/1½	2/—	2/—	May 1925	2½ p.c.
Rhodesian Congo Border	124/4½	115/—	117/6		
St. John del Rey (£1)	9/6	8/9	9/—	June 1925	6½ p.c.
San Francisco Mines (10s)	29/—	27/4½	28/3	June 1926	15 p.c.
Santa Gertrudis (£1)	20/9	19/9	20/6	July 1926	5 p.c.
Selukwe (2s. 6d.)	13/—	11/9	12/6	April 1917	6¼ p.c.
S. Amer. Copper (2s.)	4/6	4/4½	4/3	Nov. 1917	75 p.c.
Tanganyika (£1)	41/3	38/1½	40/—	Sept. 1925	5 p.c.
Tomboy (£1)	3/9	3/6	3/6	Jan. 1926	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	7.325	7.290	7.325	July 1925	150 frs.‡

* Free of British income tax. † Swiss frs. ‡ Belgian frs.